THE MODERN CAT

HER MIND AND MANNERS

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THE MODERN CAT:
Her Mind and Manners

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"The modern cat has come out of the kitchen, out of the stable, even out of the living-room, and has stepped into the scientific laboratory. There she is questioned as to her ear for tones, her eye for colour, her ways of learning mouse-hunting, her attitude toward a barking dog, her opinion as to the coming weather." (See pp. 8 and 9.)

The Modern Cat:

Her Mind & Manners

An Introduction to Comparative Psychology

By

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TO

MY MOTHER

INTRODUCTION

MANY books have been written about cats. There are cat tales for children like "Puss-in-Boots" and "The White Cat," and stories for adults such as those collected by Carl van Vechten in his *Lords of the Housetops.* Many poets have sung the charms of the feline, and the essayists, in such books as Agnes Repplier's *Fireside Sphinx,* have given us some of our most delightful descriptions and interpretations of "Pussy's" behaviour. Medical men have written a number of volumes (which the cat lover will pass over hastily) on the dissection and the anatomy of the cat. There are treatises on the care and breeding of these animals and even magazines devoted entirely to such interests. "Natural histories" contain many stories about these pets. The cat has been viewed from many angles, the legendary, the poetic, the historical, the descriptive, the medical, the economic, even the legal. Nowhere, however, do we find a volume which deals exclusively with the mind of the cat.

Many of us would like to find the answers to such questions as "Does my cat reason?" "How does she compare in intellectual ability with other animals, as the dog, the horse, the racoon, or her adversaries,

the mouse or the rat?" "Does my cat see colours as I do, hear tones as I do?" "Why does a kitten catch mice; is this act an inherited instinct or something which she is taught to do by her mother?" "Is it true that the cat always finds her way home?" "Does she always land on her feet when she falls?" "Can my cat imitate me or another cat?" "How much can she learn?" "How may I train her and why is it that some methods succeed while others fail?" "Does my cat have emotions like mine?" "How can I tell from her appearance what she is feeling?" "Does she have ideas, thoughts like mine?"

These problems are rarely mentioned in the typical book dealing with cats. Yet they are all questions on which careful experiments have been performed by students of comparative psychology. Some of the answers have been determined with approximate accuracy; in the solution of other problems only a beginning has been made.

I have tried to collect from the literature of psychology those facts which are pertinent to a discussion of cat behaviour and the cat mind. The book (like most of the other volumes) contains many "cat stories." But unlike most other treatises, it includes, with the exception of certain ones used for purposes of illustration, only "true stories," those which are as nearly accurate as science can make them. The tales are intended for two classes of readers: those who love cats and would like to know more about

the explanation for their actions, and those who may wish to obtain, through a description of methods employed with one animal, a first glimpse of the ways of comparative psychology.

I am grateful to Professors H. L. Hollingworth and A. I. Gates for reading the mansucript. My debt to three authors, Professors Edward L. Thorndike and Margaret F. Washburn, and Miss Agnes Repplier is apparent throughout the book. To Mrs. E. A. Holton grateful acknowledgment is made for permission to use a photograph and to the following for the liberty of quoting: E. H. Forbush, E. W. Gudger, *The Literary Digest, The Living Age, The Scientific Monthly.*

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THE MODERN CAT:
Her Mind and Manners

THE MODERN CAT: HER MIND AND MANNERS

CHAPTER I

THE MODERN CAT

"Keeping cats is a mad practice, something like having children, but without that consciousness of public approval, of doing one's duty and of God being responsible, which sustains the courage of parents." (*Atlantic Monthly* (2), "The Contributor's Column.")

In much the fashion in which magazines and newspapers deal with the position of Modern Woman, of the Modern Infant, of Modern Marriage, and of Modern Music, we may attempt to define, with brevity, the standing in our nation of the Modern Cat.

With the possible exception of the cow, the cat seems to the unsophisticated eye to be, of all domestic animals, the one who has most opportunity for mental activity. She wastes no time bidding for our attention or bewailing our neglect as does the dog; she performs no time-consuming labours as does the horse; she lacks to our eyes, moreover, the appearance of feeble-mindedness which distinguishes the

pig, or the preoccupation with alimentation for which the sheep and chickens are notable. You find her curled by the hour in front of the fire, or sitting all day long by the mouse hole, or on the mantelshelf looking down, or under the porch looking up. What is she doing? The simplest answer seems to many to be: "She just sits and thinks."

By providing herself thus with opportunity for contemplation the cat seems to have arranged her life in a most intelligent though possibly unethical way. She is like the lady of fashion who so directs her affairs that all necessary work shall be performed by some one else and her own time left free for pleasure. The cat gives the world nothing and receives from it everything. Like the goldfish she provides us with neither shelter, food, nor clothing (for "cat fur" though warm and pretty is for some reason socially taboo). But unlike the simple fish she suffers no curtailment of her freedom. Like the dog, she gains sufficient exercise in her own way and at her own time. But a blade of grass or a curtain tassel provides a much more accessible playfellow than a human being willing to whistle or throw sticks. And in spite of a life of relative freedom from care for food and shelter, her instinctive equipment remains such that if occasion arises, as when she is abandoned perhaps in the woods, she is much better fitted to resume a wild life than is the dog. But usually you find her in our homes. There she occupies a position much like that accorded by prim-

itive theology to the deity. Her function is to sit and be admired.

To be sure we no longer accord the cat the whole-hearted worship which the ancient Egyptians provided. We do not feel it necessary that a whole city, or even a whole family, should go into mourning on the death of a cat. We do not even shave our eyebrows when a kitten dies, nor do we maintain troops of cats in temples, fed on fish and bread dipped in milk, nor do we tear to pieces a "noble Roman" who accidentally kills a cat. On the other hand we do not view the cat with as marked uneasiness as did our ancestors of later date. If we find (and our forebears report definitely that they *did* make such discoveries), a cat on some dark night engaged in an unholy rite—such as dancing on a gravestone —and if in anger we cut off her right front paw, we do not expect next morning to discover that one of our neighbours—perhaps some shrewish old woman —has lost her right hand! Some of us even scoff at statistical evidence and are undisturbed in our belief in feline integrity when we learn that in the reports of witch-trials (collected by an eminent jurist) the Arch-Fiend appeared to his followers only sixty times as a cavalier, only two hundred and fifteen times as a he-goat, but nine hundred times as a black cat (38).

We would furthermore be offended were anyone to insist on presenting us with that medieval musical instrument, the "Cat Organ" in which sounds of

various pitches and intensities were provided by the simple expedient of pulling the tails of a number of tethered cats. A recommendation to punish a murderess (even for a most heinous crime) by hanging her in an iron cage over a slow fire, accompanied by fourteen cats (who as Agnes Repplier tells us "had killed nobody"), would be instantly vetoed by every honest citizen.

To be sure there are even now the unfriendly critics; like the modern woman and the modern dance, the cat has her enemies. Shaler (41) describes the cat as the "one animal which has been tolerated, esteemed and at times worshipped without having a single distinctly desirable quality." Students learning psychology and anatomy are required to put her to uses which would be abhorrent to the normal "cat fan." During the war the British government advertised for "common cats—any number." They were used to detect gas in the trenches, as white mice and canaries were employed in the American army. One writer (17) in an excellent treatise called *The Domestic Cat* occupies most of his space in recounting her depredations to birds, chickens, weasels, squirrels, rabbits, moles, shrews, bats, and toads, and includes in his book sections headed "Animal Substitutes for the Cat," "Methods of Taking and Killing Stray or Feral Cats," "Is the Cat a Disseminator of Disease?" The same author states that the cat's value as a mouse-trap has been much overrated, and suggests that her chief advantage

over the commercial trap is that she is "self-setting."

But most of us continue to treat the cat as a friend, as did Ben Johnson when he bought oysters for his fastidious pet, or Victor Hugo whose cat sat unrebuked on his dias, or Matthew Arnold when he described feline gambols, or Sir Walter Scott who encouraged his pet's despotic rule of his bloodhound, or Lord Chesterfield who left his cat a pension, or the Brontés, or Richelieu, or Mahomet, or Petrarch, or Henry James, or Robert Southey, or Horace Walpole, or Gregory the Great, or Cardinal Wolsey, whose intimate companion she was. We tend to applaud the action of that president of the United States who when leading a procession turned aside in order not to disturb a complacent grey cat lying in the way, and thus made a whole line of ambassadors, high officials and distinguished women detour about the animal.

We are unwilling to go so far as did the lady who inserted this well-known advertisement in a German newspaper: "Wanted by a lady of rank, for adequate remuneration, a few well-behaved and respectably dressed children to amuse a cat, in delicate health, two or three hours a day" (17).

Yet there is scarcely a person who does not stoop to pet the cat in the grocery store. We continue to permit her to occupy our hands in smoothing and stroking, to consume our milk (which the dieticians tell us is our most perfect food), to claw the rugs

and leave hairs on the upholstered furniture, to disturb our nights with her music without melody, to put us to distasteful tasks in the matter of drowning the young and wriggling.

Whether we consider her as ally or enemy, whether we believe her to be the most contemplative or only the "sleepiest" of friends, the most astute or the most stupid of our pets, we continue to be curious about her mental life (if she has one). We write to the newspapers about the exploits of our own and our neighbours' cats; we develop all sorts of theories concerning her "jealousy," her "cruelty," her "love of home," her "maternal passion."

We read about her in encyclopedias and natural histories. There we learn that relative to their size, "cats are the fiercest, strongest, and most terrible of beasts" (25), or we hear that "so far as mere agility goes, the common house cat probably surpasses all its clan, if not every known species of quadruped. It can catch its (comparatively diminutive) prey with as much skill and celerity as any tiger or jaguar" (36). The cat is distinguished among carnivora for the flexibility and strength of her spine, for her small head, her loose skin, and especially for her suppleness, speed, and the muscularity of her jaws and limbs. All the cat's "anatomy represents agility and power to the highest degree" (34).

Most interesting to the naturalist are the cat's claws. They are used to seize and hold the prey till the animal can get the better of it by biting it in the

neck. They facilitate motion on steep inclines or slippery surfaces. They must therefore be flexible and capable of a powerful grip. At the same time it must be possible to keep them out of the way when the foot is used for walking, and to prevent them from being blunted by continued contact with the ground. The muscular arrangement for protruding and retracting the claws provides for all these circumstances (34).

The fore-limbs have a freedom of motion about equal to that of the apes and monkeys. They can be stretched out, turned, can strike a blow as easily as can a man's fist (25). The tiger can smash the shoulder blade of an ox or buffalo at a single stroke and the domestic cat is, in her own realm, similarly efficient.

The rough tongue enables the cat to lick clean the bones of her prey, her teeth tear or chop or cut like scissors, but do not grind (26). One author tells us that the cat in combat represents the female sex of the carnivorous quadrupeds—displaying the "feminine traits of timidity, deceptiveness, indirectness and use of the tongue as practical weapons of offense" (36).

The feline mode of life is described as spasmodic (33). The cat alternates periods of intense activity with times of deep repose; at one time she is pursuing, springing upon, "torturing" the mouse, every muscle active; in a moment you find her curled in the corner purring. We are told that cats are very

difficult to train or tame, and that a certain "inflexibility" in their behaviour is paralleled in their structure for they go on from generation to generation with very little change in anatomical features. After three thousand years of domestication, we have very few distinct breeds of cats (33).

All very interesting and useful. But what of the cat's mind? What goes on behind those strangely inscrutable eyes? As she curls self-sufficient on the best chair, is she merely admiring her own astuteness in achieving bodily comfort, or reviewing with pride her appearance after a recent bath, or her last encounter with a mouse, or contemplating the meal to come or the meal just past? Or is she perhaps engaged in commenting critically, though, of course, sub-vocally, on her human companions or the decoration of the room? Or are her thoughts so different from these and so different from human thoughts in general that the two can only with difficulty be compared?

The modern cat has come out of the kitchen, out of the stable, even out of the living room, and has stepped into the scientific laboratory. There she presides, not in the cringing manner of the aid to medical research, but as the treasured enigma, the sphinx (no longer of the fireside), whose riddles the scientist would like to solve. She is treated (frequently, at least) as an honoured guest; problems are carefully arranged to suit her capacity. Fish of peculiarly enticing odour is provided. Mice, both

living and dead, of all sizes and consistencies, are furnished. She is questioned as to her ear for tones, her eye for colour, her ways of learning mouse hunting, her preference for light or vigorous punishment, her attitude towards a barking dog, her opinion as to the coming weather. Scientists sit about with notebooks and stop-watches contemplating her. An observer reports that his animals often "purred during the experiments" (14). Who would not?

The cat holds a prominent place in psychological research. She has the honour of acting as the chief subject in a series of experiments which marked the beginning of the laboratory study of the higher animals. The investigations had such far-reaching effects that, sixteen years after their completion, L. W. Cole complained that the psychology of mammals was still "a mere generalization of the psychology of cats" (9).

Not only did these studies initiate other researches in the field of animal behaviour, but they resulted in discoveries which were applied with marked success to the interpretation of human action. School children rejoicing in easier modern methods of learning algebra and arithmetic and even reading or spelling, would be surprised to know that their teachers had studied and were applying "principles of learning" first promulgated after prolonged study of the reactions of hungry cats! Some time before "intelligence tests" were so widely used in diagnosing human difficulties, cats were being tried

out in situations which taxed their powers of learning.

We may ask two questions about this modern cat. First, what methods shall we use in investigating her mind? Second, what are the results of such researches? First, we shall review the behaviour of the cat, what she actually does under experimental conditions. Then we may investigate theories as to how she feels.

CHAPTER II

STORIES ABOUT CATS

"Cats are a mysterious kind of folk. There is more passing in their minds than we are aware of. It comes no doubt from their being so familiar with warlocks and witches." (*Sir Walter Scott.*)

The time-worn method of investigating the animal mind is to collect anecdotes from friends, periodicals, "nature books," even perhaps from works of fiction, and having assembled a number of stories to attempt an interpretation. Many of us are inclined to do even less than this and to base our conclusions on only one or two such cases.

If you should stand on the street-corner and in the manner of a reporter on a daily paper ask the the first six persons who were willing to listen to you, "What is your opinion? Do you believe that cats reason?" you would probably get answers much like the following. These were actually collected by students of animal psychology from waitresses, clerks, elevator boys, members of their own families, and other persons whom they encountered.

"I think they do. I'm sure our cat reasons. If she hears anyone coming, she runs to a room where she can see out of the window, and looks to see who

is coming. If it is some one she knows, she comes to see them, but if it is a stranger she hides."

"Yes. Our cat enjoys being in front of the gas fire in the dining room and when the waitress did not light the fire the other morning, she looked at the fireplace and mewed."

Or you might get replies of this kind—

"I'm sure my sister's cat doesn't reason. When she calls him, he comes, but he doesn't seem to think about it. When he is hungry, he will go to the pantry and look for his food. My sister thinks this shows great intelligence, but to me he just seems to go there without thinking about it, in a lazy, half-sleepy fashion."

Perhaps half of the persons questioned will reply that cats surely do reason, perhaps the other half will answer just as certainly that feline reasoning is incredible. It will be a rare individual who will question you further and attempt to discover what you mean by "reason" or who will base his answer on the behaviour of more than one or two cats of his personal acquaintance. Whether the answer shall be favourable or unfavourable to the cat's mental powers will depend more than anything else upon the particular animals and the particular situations encountered. One man will be impressed by what appears to him to be a particularly stupid bit of behaviour. Another may just have witnessed a feat performed by a cat which, because it was unique, impressed him greatly.

Convinced of the inadequacy of such methods of inquiry, we go next to literature for anecdotes about cats. There we find essayists, novelists, and poets writing most charmingly about her whom they always designate as "Puss."

What child can resist, or what adult either, when he forgets for a moment his preoccupation with truth as science sees it, the exploits of Puss-in-Boots, of Dick Wittington's cat, of the Cat who Walked by Himself ("and all places were alike to him"), or even of the Kilkenny Cats—

> There wanst was two cats in Kilkenny,
> Aitch thought there was one cat too many
> So they quarrelled and fit,
> They scratched and they bit,
> Till, excepting their nails,
> And the tips of their tails,
> Instead of two cats, there wasn't any.

Or what reader of fairy tales does not experience regret when the unique and charming little White Cat was beheaded by the Prince and turned on the instant into an ordinary, every-day Princess?

The most delightful legend about the cat is perhaps the following, a story found in the mythology of many countries, which is here quoted as Shelley told it.

"A gentleman on a visit to a friend who lives on the skirts of an extensive forest, on the east of Germany, lost his way. He wandered for some hours among the trees, when he saw a light at a distance.

On approaching it, he was surprised to observe that it proceeded from the interior of a ruined monastery. Before he knocked, he thought it prudent to look through the window. He saw a multitude of cats assembled around a small grave, four of whom were letting down a coffin with a crown upon it. The gentleman, startled at this unusual sight and imagining that he had arrived among the retreat of fiends and witches, mounted his horse and rode away with the utmost precipitation. He arrived at a late hour at his friend's house, who had sat up for him. On his arrival, his friend questioned him as to the cause of the traces of trouble visible in his face. He began to recount his adventure with some difficulty, knowing that it was scarcely probable that his friend should give faith to his relation. No sooner had he mentioned the coffin, with the crown upon it, than his friend's cat, who seemed to have been lying asleep before the fire, leaped up, saying, "Then I am the King of the Cats!' and, scrambling up the chimney, was seen no more."

This tale is quoted in a pleasant book by Marion Clark, published in 1895, and called *Pussy and Her Language* (8). There the author suggests ironically that the story shows not only the attention which cats (even when apparently indifferent) pay to human conversation, but also the "monarchical character of their political organization."

A similar tale in verse is described as a characteristic legend of Northern Nations.

THE TROLL CAT

Knurremurre rules with a will
All the trolls in Brondhor Hill.
Throughout all Zealand has it rung—
The fame of Knurremurre's tongue.
One young troll got tired of the worry,
"I'll away," said he,
"To company
More pleasant than Knurremurre."

"Wife, what scratching at the door
On this cold winter night?"
The gales through the snow-heaped forests roar,
And the hut-fire is burning bright.
"Open the door, good wife," says Plat—
In walks a stately whiskered cat,
He sits by the fire and dries his fur,
And purrs his thanks with a loud long purr,
And eats his groute and washes his face,
And makes himself at home in the place.

Weeks pass on, a good cat he,
He is quite one of the family,
For the kindly wife of Plat,
In her wooden hut by the northern sea,
Has a poet's love for a cat.
'Tis night; the cat by the hearth fire lies
Purring and dozing with blinking eyes;
When Plat comes in and says—
"Good wife!
What strange things happen in one's life!
I saw a sight
As I came tonight
By Brondhor Hill,
Where all was still

Save the trolls who hammered below with a will,
Out jumps in my way
A man old and gray,
And squeaking he said—
'Hearken, Plat!
Tell your cat
That Knurremurre is dead.' "

Up jumped the cat from the hearth-fire side—
"Ho! Knurremurre dead!" he cried—
"Now I may go home, I ween."
And out he scampered with a will
Out through the night to Brondhor Hill,
And nevermore was seen.

In humorous vein, Clark describes the consternation which would ensue did it become generally known that the "little innocent who hears the family secrets," "the ever-present spy," was capable of communicating her information. That this is the case, that the "feline community" does possess a language of its own has been revealed to him by a mysterious document, called "The Discovery of the Cat Language," left to him by a gentleman who bore a card reading

ALPHONSE LEON GRIMALDI, F.R.S., F.b.S., M.O.
D.H. du C., M.F.A.S., M.F.A., et al,
Rue de Honore, 13, Paris. Metropolitan Hotel, N. Y.

The article, which was much gnawed by mice, though the author does not know whether "in a spirit of vandalism and to demonstrate the hatred of the destroyer for the subject of the story, or with

a mere wanton desire to destroy my property," is described as an attempt to demonstrate not only that the cat is a more delicate organism than the dog; that she is of a higher order of intelligence than any other four-footed beast; that with proper opportunity, she would lose those attributes which make some of us dislike her and acquire dog-like characteristics; but also that she possesses a language much like the Chinese and possibly derived from it. In the word part of the language there are, probably, not more than six hundred fundamental words, all others being derivatives.

I shall quote a few of these words for the benefit of those individuals who may be moved to communicate with their pets in this fashion.

"Purr-r-r-r-r-r-rieu" means "happy," "mieouw" with a strong emphasis on the first syllable "beware," "aelio" is "food" and "alieeo" is water, "parrierre" is uttered in front of the door and means "open," the numbers begin "aim, hi, zali," "leo" is the head, "tut" the tail," "oolie" the fur, "ptter-bl" is mince-meat and "bleeml-bl" cooked meat. The sentence "mie-ouw, vow, vow, teiow you tiow, wow yow, ts-s-s s-syw," is a mixture of defiance and a curse and much resembles "bold, bad swearing."

Many cats who do not aspire to the gift of language are famous, not because their own behaviour was in any way unique, but because their masters, men of talent, interpreted it so delicately and charmingly.

Such was Pierre Loti's Moumoutte Chinoise, described by Agnes Repplier as the "Jane Eyre of pussies, ugly, intelligent, secretive, passionate, self-controlled, intrepid and vivacious" (38), or Gautier's various cats, including Madame Théophile and Eponine. The latter is described as being most hospitable, willing to receive guests and entertain them till her master enters, having, moreover, her own place at the table, where she behaves "with a gentleness and decency which might be imitated by many children. She is very punctual, coming as soon as she hears the bell, and when I enter the dining-room, I find her already in her place, her paws folded on the tablecloth, her smooth forehead held up to be kissed, like a well-bred little girl who is politely affectionate to relatives and older people" (38).

As the astronomer does not take account in his writings of imaginative tales of life on the moon, nor is the physicist disturbed by H. G. Wells' stories, so the comparative psychologist can make no use of such tales other than to admire and enjoy them. The stories of "Puss" depicted as a graceful lady, an astute cavalier, a monarch, a gossip, entertain us greatly, but give us no real information concerning the cat mind. We turn to "nature books," or to magazines or newspapers purporting to describe the behaviour of these animals with approximate accuracy, and to advance, in some cases, arguments con-

cerning their reasoning powers. We find cats famous for various causes.

One animal, whose name is now Thomas Cadillac, became well-known because, shipped by accident from America to Sydney, Australia (a seven weeks' trip), within a Cadillac chassis with nothing to eat but grease, oiled paper from the engine and, of course, the book of instructions, he survived the ordeal. He subsequently had his life insured for $5,000, posed for the motion pictures, and dined from the gold service at the Palace Hotel in San Francisco. The evidence provided here is of the type to favour the theory of nine lives rather than that of high intelligence.

Other stories describe instances of friendships between cats and dogs, or cats and horses, or even cats and mice. There are tales of cats who adopted puppies or chickens, cats who fought successfully with hawks and alligators, who resented injuries, accused murderers, punished marital infidelity, were excessively fond of brandy or valerian, of cats who came to their owners and attempted to communicate bad news, as the death of a kitten. "John Harvard" was famous, not only because, in spite of her name, she produced three kittens, but because on the night when the family decided to get rid of her, she warned them, by her mewing, of a conflagration, and thus saved not only their four lives, but her own nine.

Such stories are entertaining mainly because of

the singular character of the incidents described, rather than because of the light which they may throw on the possible reasoning powers of cats. Other tales are definitely intended by their writers to be evidence of the unique intellectual ability of the feline.

In Cassell's *Popular Natural History,* published 1817-1865 (6), we find the following somewhat gruesome tale of wisdom rewarded. "De La Croix witnessed, however, a display of extraordinary sagacity. 'I once saw,' he says, 'a lecturer on experimental philosophy place a cat under the glass receiver of an air-pump, for the purpose of demonstrating that very certain fact, that life cannot be supported without air. The lecturer had already made several strokes with the piston, in order to exhaust the receiver, when the animal, who began to feel very uncomfortable in the rarefied atmosphere, was fortunate enough to discover the source whence her uneasiness proceeded. She placed her paw on the hole through which the air escaped, and thus prevented any more from passing out of the receiver. All the exertions of the philosopher were now unavailing; in vain he drew the piston—the cat's paw effectually prevented its operation. Hoping to effect his purpose, he let air again into the receiver, which, as soon as the cat perceived, she withdrew her paw from the aperture; but whenever he attempted to exhaust the receiver, she applied her paw as before. All the spectators clapped their hands in admiration

of the wonderful sagacity of the animal and the lecturer found himself under the necessity of liberating her, and substituting in her place another, that possessed less penetration and enabled him to exhibit the cruel experiment.' " Perhaps the astute reader can discover some explanation of the cat's behaviour less exciting but more probable than "penetration" and "wonderful sagacity."

In a book called *Sketches and Anecdotes of Animal Life* written by the Rev. J. G. Wood, M.A., F.S.S., etc., in London in 1861 (66), the purpose of which was "to see how that portion of reason implanted in animals can overcome their natural instincts whenever the occasion requires," we find this event described—

"Four cats, belonging to one of my friends, had taught themselves the art of begging like a dog. They had frequently seen the dog practise that accomplishment at the table, and had observed that he generally obtained a reward for so doing. By a process of inductive reasoning, they decided that if they possessed the same accomplishment, they would in all probability receive the same reward. Acting on this opinion, they waited until they saw the dog sit up in begging posture, and immediately assumed the attitude with imperturbable gravity. Of course their ingenuity was not suffered to pass unrewarded and they always found that their newly-discovered accomplishment was an unfailing source of supplies for them."

This story is of value in connection with our subsequent discussion of the experimental evidence for the existence of imitative ability in the cat.

The same writer, in a volume called *Illustrated Natural History* (65), describes a mother cat's behaviour when her kitten was given to him.

"Minnie knew perfectly well that her kitten was going away from her and, after it had been placed in a little basket, she licked it affectionately, and seemed to take a formal farewell of her child. When I next visited the house, Minnie would have nothing to do with me, and when her mistress greeted me, she hid her face in her mistress' arms. So I remonstrated with her, telling her that her little one would be better off with me than if it had gone to a stranger, but all to no purpose. At last I said, 'Minnie, I apologize and will not so offend again.' At this remark Minnie lifted her head, looked me straight in the face, and voluntarily came on my knee. Anything more humanly appreciative could not be imagined."

Shall we credit this to understanding of language or to something much simpler?

Clark quotes a story of a cat who, when her master was sick, assumed the position of head nurse and directed when medicine was to be taken—"It was truly wonderful to note how soon she learned to know the different hours at which I ought to take medicine or nourishment, and, during the night, if my attendant was asleep, she would call her, and if

she could not wake her without such extreme measures, she would gently nibble the nose of the sleeper, which never failed to produce the desired effect." She was, furthermore, "never five minutes wrong in her calculation of the time," even though there was no striking clock in the house "amid the darkness and stillness of the night."

The master's amazement would have been changed —at least in its direction—had he some knowledge either of the laws of evidence or of feline psychology.

Romanes, one of our most famous writers on animal behaviour, describes in *Animal Intelligence* (40), which was "an attempt to write something resembling a text-book of the facts of Comparative Psychology," various anecdotes about cats. These animals, he says, "in the understanding of mechanical appliances . . . attain to a higher level of intelligence than any other animals, except monkeys and perhaps elephants."

He gives one instance of "zoological discrimination." A cat, who was in the habit of poaching young brown rabbits to "eat privately in the seclusion of a disused pigsty," one day caught a small black rabbit and, instead of eating it, as she always did the brown ones, brought it into the house unhurt, and laid it at the feet of her mistress. "She clearly recognized the black rabbit as an unusual specimen, and apparently thought it right to show it to her mistress."

Again, one is inclined to ask whether the author

is reading more into the cat's mind than is implied by her behaviour.

Romanes describes cats who, when they want milk, summon servants by pulling the wires of bells.

"My informants tell me that they do not know how these cats, from any process of observation, can have surmised that pulling the wire in an exposed part of its length, would have the effect of ringing the bell, for they can never have observed any one pulling the wires. I can only suggest that in these cases the animals must have observed that when the bells were rung, the wires moved, and that the doors were afterwards opened; then a process of inference must have led them to try whether jumping on the wire would produce the same effects. But even this, which is the simplest explanation possible, implies powers of observation scarcely less remarkable than the powers of reasoning to which they gave rise."

He tells us this tale also:

"To give only one other instance of high reasoning power in this animal, Mr. W. Browne, writing from Greenock to *Nature* (vol. XXI, p. 39), tells a remarkable story of a cat, the facts in which do not seem to have admitted of mal-observation. While a paraffine lamp was being trimmed, some of the oil fell upon the back of the cat, and was afterwards ignited by a cinder falling upon it from the fire. The cat, with her back in a blaze, in an instant made for the door (which happened to be open) and sped up

the street about 100 yards, where she plunged into the village watering-trough, and extinguished the flame. The trough had eight or nine inches of water, and puss was in the habit of seeing the fire put out with water every night. The latter point is important, as it shows the data of observation on which the animal reasoned."

Romanes' best story, since made famous by another investigator, we shall save for the next chapter, where we shall also include a more probable explanation of the behaviour just cited.

It is not only in the older text-books that we find remarkable tales of animal prowess. Newspapers and magazines are full of such stories today.

The *Literary Digest* for November 8, 1924, reports this story of thwarted cunning, which was entered in an animal contest held by the *Boston Post*. Fred G. George, of Meriden, Conn., is the author of the tale.

"As a general thing, cats are not noted for their reasoning powers, but an incident which happened recently in our yard has proven that they do at times show considerable cunning.

"We have three adult cats at our house and in our front yard is a maple tree where squirrels make their home; on the side of our house, about 100 yards from the maple tree, is a hickory-nut tree, and between these two trees the cats and squirrels have been running races for some time, with the squirrels always winning by inches. The cats

seemed to realize that it was a waste of effort to catch Mr. Squirrel, so seemed to grow indifferent as to his presence, but it would seem that they were plotting the downfall of their enemy.

"One day, as a squirrel left his home tree for his morning meal on nuts, the three cats sat lazily blinking; suddenly, as if by pre-arrangement, 'Tom' made a bee-line for the walnut tree, 'Blackie' made a wide detour to get on the opposite side of the squirrel's route; the white cat remained stationary, but on the alert. Suddenly the two cats rushed Mr. Squirrel, who quickly 'about faced' so that the two cats came together in a terrific head-on collision. As they sat gazing at each other in a dazed condition, the squirrel was laughing at them from his 'home' tree, while 'Tom' sat lazily blinking at the base of the walnut tree."

W. H. Hudson, writing in the *Living Age* (June 18, 1921) (23), attempts to prove that cats "have something more than just the unreflecting intelligence which we find in all creatures, from whales and elephants to insects—something which in many instances cannot easily be distinguished from what we call reflection in ourselves." He tells the story of a lady who served afternoon tea in the garden and at the same time a tea of bread and cake for the birds. Her cat was in the habit of stalking the birds who congregated, but "invariably, just before the moment for making his dash, they would fly up into the branches of a tree." This continued appar-

ently for some days (the number is not stated), when, instead, the cat seated himself in the middle of the "becrumbed area" and waited for the birds to come down. He waited for an hour, then walked away and repeated this procedure for three days; on the fourth day he did not even look at the birds and never thereafter did he pay any attention to them. "In this instance, the cat had made a fool of himself all the time, a bigger fool when he changed his strategy than before—but the very fact that he did change it appears to show reflection. He didn't know the mind of a bird as well as we do, but he hit on an idea—one must use the word in this case—that it was his conspicuous advance over the smooth lawn which alarmed and sent them away; that if he dispensed with the advance and established himself beforehand where the food was, and sat still, they would come to devour it and he, being on the spot, would have no difficulty in catching them! After giving this second plan three days' trial, he was convinced that it was as useless as the former one, and so gave it up for good." Again, even a superficial acquaintance with the methods of learning employed by animals would have led this writer to make a vastly different interpretation of the cat's behaviour.

He tells another story of a cat who experienced difficulty in transporting her kittens; she then remembered her friend, the dog, "mentally visualizing him as a big, strong creature with a big mouth to carry, and remembering also that he was obedient

to her and quick to respond to her wishes.". . . "Her actions undoubtedly show reasoning of a higher kind than that of the cat described in the first part, though that too was reasoning. His impulse was to dash at the bird, but in the pause before it could be made, he listened to the still small voice of the higher faculty telling him that he would fail again as he had failed many times before."

Our crowning anecdote (23), purporting to prove the ability of the cat, is a case of telepathy, the first ever met with between human and cat. This is of unusual importance, for, as the author tells us—"that such communication between mind and mind . . . should be possible between man and animals is but a further proof that they are mentally very near to us; that their brains function even as ours do, far as we have risen above them in all mental powers."

Mrs. Barry, the wife of the late Bishop Barry, possessed a cat which was most unusually attached to her mistress because she had saved the cat's life from a dog just two minutes (note the scientific accuracy!) before her first kitten was born. The cat lived in a house that was supposed to be haunted, but the raconteur admits quite openly, "I do not know whether it could in any way have affected the cat."

The animal was left in charge of the gardener during the absence of her mistress, who one night dreamed that she was walking on a favourite path where the cat was accustomed to follow up and

down. The lady heard a piteous cry and, looking up, saw "Puss" starved to death and very weak. The cat came to her three times (note the scientific accuracy of the figure) that night.

In spite of the protests of her family, Mrs. Barry rushed off the next morning to succor the cat, and found, of course, as happens in all good stories of telepathy, the identical animal in the identical spot and condition. She states, "This story is perfectly true. Who can explain the fact of the cat spirit being able to make an impression on a human spirit so as to induce me to act as I did and in time to save her life?"

This tale makes a fitting end to our survey of cat stories.

CHAPTER III

THE EXPERIMENTAL METHOD

"There is no answer, there is no answer to most questions about the cat. She has kept herself wrapped in mystery for some 3,000 years, and there's no use trying to solve her now." —*Virginia Roderick* (39).

SHALL we accept these tales as fact and shall our picture of the cat mind be a composite portrait drawn from such sources, or is there some other method which will give a better understanding of feline intelligence? What are the objections, first of all, to the anecdotes just described? What would a scientist say if you told him one of these stories and asked for his comment upon it?

He might, if sufficiently interested, ask three questions: 1st. Is this story true? did the events really happen just as described? 2nd. If all the circumstances are as pictured, is the interpretation given by the story-teller adequate? 3rd. How many events of this kind can be reported? Is this merely a chance occurrence or one of many representative instances?

How can we tell whether the tale is true? Is it advisable to depend on the accuracy of observation of the story teller? Some of our tales are very old

and the cats have been dead fifty or a hundred years and their masters possibly half as long. Even where our stories come from contemporaries, we have no means of questioning them further. Can we be certain that two independent observers would agree? Many of the events were witnessed by clergymen, bishops, personal friends of the writer, etc. Are even educated and intelligent persons always accurate observers?

We may recognize the good intentions of the writers, and applaud their efforts to observe with care. Yet we may doubt their ability. A comparison of witnesses often reveals discrepancies. Five psychologists and a physician (all persons who had been trained to observe accurately) were walking in the woods one day when a man approached, pointed a pistol at them, and after some discussion of the right of way over the property, permitted them to depart. After the event, the friends compared their impressions. Two of the observers had seen a young woman in knickers with the gunman, one had seen a young boy with him, one had seen a child, two had observed no companion. One said the man held a mask in his left hand, another that he had a bunch of grasses, the others that he carried nothing. One had observed him wearing spiral leggings, another leather puttees, another golf stockings. The only fact on which the friends agreed was that the gentleman they met certainly had a pistol and certainly had pointed it in their direction. When trained

observers disagree thus on facts in which they can have no personal interest or bias, how can we expect men of less experience always to be accurate when they are trying to tell a good story about a beloved cat?

Romanes states concerning his stories that "the most remarkable instances of the display of intelligence were recorded by persons whose names were more or less unknown to fame. This, of course, is what we might antecedently expect, as it is obvious that the chances must always be greatly against the more intelligent individuals among animals happening to fall under the observation of the more intelligent individuals among men" (40).

Even this most credulous student of animal behaviour notes a negative relationship between a good story and a famous man. His interpretation of the fact is probably inaccurate. Possibly his less intelligent observers were merely the more credulous.

Intelligent and unintelligent observers alike suffer from the following disadvantages, according to Washburn (59), any one of which may be illustrated by the stories in the preceding chapter. The story-teller is neither scientifically trained to distinguish what he sees from what he infers nor intimately acquainted with the habits of the species to which the animal belongs, nor the past experience of the individual animal. Furthermore, he usually has a personal affection for it, a desire to show its superior intelligence, and to tell a good story.

These last objections apply not only to the accuracy of the observation, but also to the validity of the interpretation, the second point which our scientist would question. A gentleman who had just come from Chicago to New York, went to call upon a medium there, without telling any of his acquaintances of his intention. After taking off his coat and hat, he was ushered into the seer's presence. She greeted him with the words, "How are things in Chicago?" This man could interpret this occurrence in various ways. He could believe that a "spirit-control" had told the medium about his recent arrival in the city. He could think that the seer possessed the power to read his mind and so would know that his thoughts were still concerned with his journey. He might decide that mediums have some elaborate and mysterious organization that enables them to secure information concerning all their visitors, or he could merely recall that his overcoat bore the label of a Chicago firm and that the words, "How are things in Chicago?" implied no further knowledge of his connection with that city than that he had been there long enough to buy an overcoat; and that this sentence would be equally startling, were he in the mood to be amazed, had he left the city the day before or a year previous.

Which interpretation shall he choose? The explanations in terms of thought transference, or communication with the dead, are more exciting to the human imagination and make, in general, more re-

markable stories. Learning one's previous home from a label on an overcoat is a commonplace procedure which any ordinary individual could employ. What makes the medium entertaining is that she claims to be a person of extraordinary ability, and the raconteur naturally prefers evidence of supernatural powers. The scientist, however, warns him against this tendency and tells him that in order to compensate for it he must make especial efforts always to consider and to give preference to the simplest explanation.

So, if we wish to approximate the truth in our interpretation of cat behaviour, we must take account of this habit of enjoying the unusual and accepting the marvelous; and even though we should like to believe that our cat understands our language, can tell time, appreciate the suction pump, love and hate as we do, we should still continue our search for a simpler and more credible interpretation of behaviour. The stories in the last chapter can all be explained quite readily, as we shall see presently, either on the basis of errors in observation or errors in interpretation.

Furthermore, this warning to prefer the simplest explanation reminds us that the stories represent only one side of the picture, animal intelligence rather than animal stupidity. The man who goes to a medium and hears nothing at all unusual, rarely tells his story, certainly he never publishes it. Thorndike says, "Thousands of cats on thousands of

occasions sit helplessly yowling, and no one takes thought of it or writes to his friend the professor; but let one cat claw at the knob of a door, supposedly as a signal to be let out, and straightway this cat becomes representative of the cat-mind in all the books" (52). A cat book or a cat magazine giving instances only of feline stupidity would probably not be well received.

There is another method of investigating the accuracy of these stories, other than that of doubting the competence of the witnesses, the validity of the interpretation, or the universality of the behaviour. This is the method of experiment which the psychologist has for a number of years been applying to cats as well as to other animals.

The scientist who investigates the cat mind, first carefully observes the behaviour of the animals, then makes inferences as to their "thoughts." He may attempt, in considering such anecdotes as those we have cited, to arrange a situation similar to that of the story and to observe whether other cats of presumed equal intelligence, are capable of performing the feat.

Consider the following story, told by Romanes (40):

"My own coachman once had a cat which, certainly without tuition, learnt thus to open a door that led into the stables from a yard, into which looked some windows of the house. Standing at these windows, when the cat did not see me, I have

many times witnessed her *modus operandi.* Walking up to the door with the most matter-of-course air, she used to spring at the half-loop handle, just below the thumb latch. Holding on to the bottom of this half-loop with one forepaw, she then raised the other to the thumb piece and, while depressing the latter, finally, with her hind legs, scratched and pushed the door posts so as to open the door.

" . . . We can only conclude that the cats in such cases have a very definite idea as to the mechanical properties of a door; they know that to make it open, even when unlatched, it requires to be pushed —a very different thing from trying to imitate any particular action which they may see to be performed for the same purpose by man. The whole psychological process, therefore, implied by the fact of a cat opening a door, is really most complex. First, the animal must have observed that the door is opened by the hand grasping the handle and moving the latch. Next, she must reason, by 'the logic of feelings'—'If a hand can do it, why not a paw?' Then, strongly moved by this idea, she makes the first trial. The steps which follow have not been observed, so we cannot certainly say whether she learns by a succession of trials that depression of the thumb piece constitutes the essential part of the process or, perhaps more probably, that her initial observation supplied her with the idea of clicking the thumb piece. But, however this may be, it is certain that the pushing with the hind feet, after

depressing the latch, must be due to adaptive reasoning, unassisted by observation, and only by the concerted action of all her limbs in the performance of a highly complex and most unnatural movement is her final purpose attained" (40).

Consider, also, this story and interpretation of more recent date, originally printed in the New York *Times* and quoted here from the *Cat Journal* for February, 1910:

"That the lower animals reason I have stacks of evidence, which have grown greater and greater through twenty years of work in animal psychology, grown from my own observation and that of correspondents in all quarters of the globe. Having formed the habit of psychological observation, there does not go by a day which does not give me some new evidence that the lower animal is essentially simply man; the difference between man and the lower animal lying in the plan, size, and proportions, and not in the material used in construction."

One of the instances on which these pronouncements are based is the story of a cat who was shut up for the night in a shed. She was observed by watchers outside to mew, to scramble up the door, and then "wonderful things happened." The bar between the knobs rattled. Then the knob on the kitchen side of the door partly turned. "What was happening to the knob on the shed side of the door? Pixie was trying to open it."

But Pixie was unsuccessful, and the next night the same phenomena occurred again. "In this action, what had she in view? The turning of the knob, which turns the bolt, which withdraws the latch, which holds the door, which closes the passage between the shed and the kitchen. Since the third night of her imprisonment, Pixie has not touched the knob nor made any fuss. Why? Because she is intelligent enough to know that any effort to get into the kitchen will not attain its end."

Apparently, whether the cat opens the door or fails to do so, her action is interpreted equally well as an example of marvelous intelligence. She seems in both cases to understand, with surprising completeness, the mechanics of door latches.

In order to investigate such occurrences as these, to discover whether they ever happen as described, and whether, if they do, they are correctly interpreted or are common events in cat-life, it is necessary so to arrange events that the behaviour shall occur before the eyes of competent witnesses, prepared to record it, and well versed in the difficult art of separating their theories from their observations. The experiments must be so described that they may be repeated by other independent observers. Many cats must be tested on many occasions. The situation must be such that it is greatly to the cat's advantage to perform a certain feat, or to solve a certain problem. Then one may observe how she goes about it.

Thorndike in 1898 performed the most famous of animal experiments (52). His apparatus consisted of various boxes with doors which might be opened by animals, by such simple methods as pulling at a loop or cord, pressing on a lever, turning a button, or stepping on a platform. His first subjects were twelve most commonplace cats, who were picked up in the street. A cat who had not yet had her breakfast was put in one of the boxes; a piece of fish was left outside. The experimenter recorded what happened.

Observe the similarity of the situation to that described by Romance and the other story-teller. The cat has a strong motive for escape, she is hungry and food is in sight. The door opens readily by some simple mechanical device. As a matter of fact, the problems presented to these twelve felines were easier than those described by Romanes, since the cat's activity was confined to a relatively small area. When loose in a room she might, in her efforts to escape, investigate windows, floors, walls, as well as the door; in the boxes described by the experimenter the amount of space which she might explore was much less extensive. Observe also the dissimilarity in the situations; in one case a story recounted by an untrained observer, perhaps some months after the event; in the other, we have the careful record of the behaviour of the cat made at the moment it occurred. In the one case, we have only one cat, in the other about a dozen.

What does the cat do in such a situation? If you confined a college professor in similar fashion, locking him in a cell and placing a book just outside which he much desired to read, you would find him, probably, after a few moments of surprise and incredulity, going systematically over the walls, floor, and ceiling of his cell in an effort to discover some device which would permit escape. Failing in his search the first time, he might repeat his performance, being careful to omit no part of the box and paying especial attention to certain areas which might seem to offer clues. You might see him sitting down with his head in his hands, trying to "think out" some answer to his problem. If pencil and paper were available, he might be observed figuring or drawing. If you found such behaviour, you would probably describe it as "rational," as implying "reasoning" and "thought."

Suppose that he discovered the exit, and after permitting him to read a chapter of his book, you put him in again. You would expect that during the first solution he would have "seen through" the problem and would therefore know what button to turn, which latch to unfasten, and so would now escape instantly.

Does the cat, confronted with a similar situation, react in this manner? Does she work systematically, give an appearance of deep thought, or show during a repetition of the experiment that she has profited by her experience? Our anecdotes would lead us to

suppose that she would behave much as a man would in similar circumstances.

This is what happens in a typical case. The cat gives evidence of discomfort—often vocal. "It tries to squeeze through any opening; it claws and bites at the bars and wire; it thrusts its paws out through any opening and claws at everything it reaches; it continues its efforts when it strikes anything loose or shaky; it may claw at things within the box. It does not pay very much attention to the food outside, but seems simply to strive instinctively to escape from confinement. The vigor with which it struggles is extraordinary. For eight or ten minutes it will claw and bite and squeeze incessantly" (52).

You have then a picture of a struggling, fighting cat, rather than of a contemplative cat. The animal shows no signs of studying the situation or of proceeding in systematic analysis. Such statements, of course, are merely inferences from behaviour, and the psychologist who based his conclusions wholly on the mere appearance or lack of appearance of "reasoning," might well be criticized.

But we have further facts. The cat's solution is an accidental one. It happens by chance, during the varied clawing and struggling. In the course of the cat's strenuous activity, her paw accidentally pulls the loop which means release. The door opens, the cat escapes, and is fed.

Furthermore, one experience in the box does not

teach the animal a method of escape. After she has eaten a little of the fish, the cat is put back. Does she immediately walk to the loop, pull it, so as to obtain release and more fish? Does she realize, as we might say, how she previously obtained her freedom and immediately go through the movements which before brought her satisfaction? Does she think, "When I pulled the loop the door opened," or perhaps, "When I was on that side of the box I escaped," or even, "It was something I did with my right paw?" Does she understand the situation even vaguely? She apparently does none of these things, but merely goes through the same series of reactions: biting, struggling, mewing, varied movements! Again, in the course of battle, she hits the loop by accident and is released. Perhaps the time required for escape is a little shorter on the second occasion, though it may well be a little longer. It looks as though she had profited not at all from her experience.

Yet you find, if you continue the training, if you put her in the box not only once or twice, but a third time, a fourth time, perhaps a twentieth time, that she does learn something. Gradually the period required to escape grows less, gradually the mewing ceases, the biting drops out, the attempts to squeeze between the bars are eliminated. Finally she reaches a point where as soon as she is dropped in the box, without making any other movements, she pulls the loop. She has learned the trick!

Figure I presents some curves showing the time required by two cats to learn to escape by clawing a button and thus turning it from a vertical to a horizontal position. The height of the line shows the

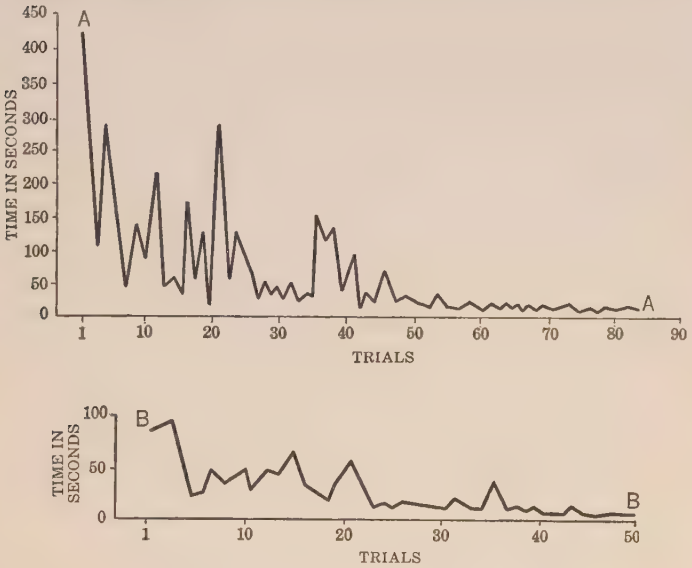

FIG. I.—Time curves for each of two cats who learned to escape from a box by clawing a button. After E. L. Thorndike, *Animal Intelligence.*

amount of time required by the cat to escape during each of the trials which are represented along the baseline. Figure II shows some curves representing in similar fashion the time required by college students to solve simple mechanical puzzles.

There is one very significant difference between

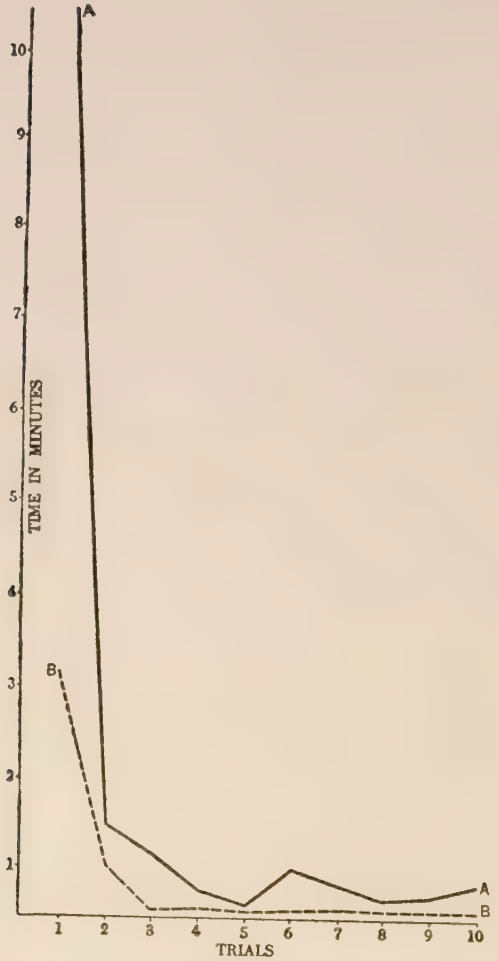

FIG. II.—Time curves for each of two students who learned to solve a mechanical puzzle by the "human method."

the graphs of the cats and the graphs of the girls. The cat curves are gradual, there are no sudden and sharp descents which affect materially the subsequent course of the curve. The cat required perhaps seven minutes the first time, two minutes the second, five the third, and so forth. She does not change suddenly from five minutes to two seconds and then remain at the low level. The human graphs, however, each display a quick drop, a place where the time required falls sharply from possibly ten minutes to two, after which it varies comparatively little. Such a change is caused usually by the individual suddenly gaining "insight" into the situation, suddenly understanding what is to be done. Then she does it immediately without the fumbling about previously necessary. These evidences of the functioning of ideas or notions about the problem are entirely lacking in the performance of cats.

If you had observed the cat only on the final occasion, you might be moved to marvel as Romanes did at the wonders of animal reasoning powers and to make all sorts of gratuitous assumptions regarding the cat's understanding of mechanical contrivances and the complexity of her ideas. You might say, "See, she understands that pulling the loop will open the door." Yet the cat understands nothing, she does not see through the situation. All that has happened is that the tendency to claw the loop has been strengthened through repetition and through the fact that it has brought release and food, whereas

the tendencies to make those movements of biting, mewing, struggling, which brought only continued discomfort, gradually disappeared. The cat learns to escape from a box much as a child learns to button his coat. He does not think, "I will hold the button thus and push it thus." Instead, he struggles with it, twists it first this way, then the other. After several experiences with buttons, he learns to operate them immediately. That method of holding the button is retained which has brought him satisfaction. Those methods of handling have been eliminated which were awkward, uncomfortable, unavailing. He probably thought little about the matter other than to be pleased at his final achievement.

Such learning contrasts with that of our college professor who, having opened the door once, knew immediately, on the second occasion, which movements to make; or with that of the man who is trying to guess the solution of a riddle and who, having guessed it once, is immediately able to give the answer if you propound it to him a second time; or with that of the college students who saw through the puzzle. The cat's behaviour in learning to operate a mechanical contrivance such as we have described, differs from that which the average man describes as "reasoning out a problem," in that it typically involves varied activity of the muscles rather than contemplation, accidental rather than planned success and learning which involves the

gradual disappearance of useless movements rather than sudden insight.

As examples of the kind of things which cats can learn readily, we may give the following data. All the cats who were tried in boxes that opened by pulling a loop which hung down the front of the box or one that hung down the back, or by pulling a string within the box or a string outside, or by pressure on a lever, were successful in learning to escape. Four out of five cats failed when the string must be pulled in just one direction, five out of eight when not only must a thumblatch be opened, but the door pushed in order to escape, two out of five when two separate acts were required for release (pulling a loop and knocking down a board), and two out of five also when three acts were required (depressing a platform, pulling a string, and pushing a bar). Some cats were permitted to escape as soon as they had licked themselves, others as soon as they had scratched themselves. Again they were capable, after a number of trials, of learning to bite or scratch very soon after they had been placed in the box.

Perhaps these simple experiments considered in connection with our discussion of scientific precautions will help to explain the cat stories cited in the preceding chapter. We may criticize either the accuracy of the description or the adequacy of the interpretation of these tales. We feel no hesitation in doubting the facts in the legend of the cat who

vanished up the chimney saying, "Then I am the King of the cats," or in the story of the discovery of the cat language, or of the marvelous case of telepathy between woman and cat.

Similarly, we may be led to doubt the story of the kitten who was such a perfect timepiece that she not only remembered the hours when medicine was to be given, but was "never five minutes wrong." Perhaps once or twice (induced by some slight restless movement on her master's part) she chanced to come to the nurse at the proper moment and her enthusiastic owner, who was ill at the time, in recalling the incident, believed that she acted with clock-like regularity. Or perhaps she did come many times, but always in response to some signal given, possibly unconsciously, by her master or the nurse.

We may, if we care to, admit the facts in the other stories and still doubt the explanations. The cat who is alleged to have accepted an apology probably just happened to lift her head at the right time, the cat who looked at the fire and mewed when she was cold probably mewed and looked at the fire on many other mornings when she was not cold, and the fire was not needed. There is no reason for assuming that three cats simultaneously chased a squirrel, were "plotting the downfall of their enemy," or that a cat who reacted differently to two kinds of rabbits was capable of "zoological discrimination," or that putting out fire by jumping in the water implies anything more than an accidental vigorous reaction

to a most annoying stimulus. The behaviour of the cat who, during the "philosophic experiment," placed her paw over the hole when the air was drawn, may have been due either to accident or to the mechanical action of the suction pump. One notes that when air was forced in, the paw, no longer drawn to the hole, was removed. Preferring the simplest explanation, we need not assume "wonderful sagacity" or "penetration." The stories of the cats who ceased their efforts to catch birds or to open doors when such attempts were unsuccessful, the tales of the cats who learned to pull wires, open doors or beg, when such feats brought them food, petting, or release from confinement, are all quite readily explained as cases of gradual learning, of the elimination of some movements, the strengthening of others.

We have emphasized throughout the chapter the difference between the way in which cats learn and the way in which a man solves a similar problem. The man thinks, the cat scrambles. But that is not the whole story. One should not leave the reader with the impression that human learning is always of an entirely different kind from cat learning. There are similarities as well as differences.

Suppose that your college professor, instead of being locked in a cell, was thrown into the college swimming pool. Suppose that he had not "gone swimming" since he was a boy. You would not find him sitting down and thinking, but instead, making

countless "random" movements. Some of them would succeed, some would fail. Those which tended to keep his feet in the air and his head in the water would disappear. Those which had the effect of keeping his nose above the surface would tend to be repeated. This might happen without his thinking about the matter at all. He might not say to himself, "If I wave my arms thus, I feel easier," or "Lifting the feet too high has an unfortunate effect." He might merely react, continue the satisfying and discontinue the unsatisfactory responses. The next time you threw him in he would probably still flounder, but perhaps not quite so much. The next time still less. If you continued the treatment for a sufficiently long period, he might learn to swim off gracefully as soon as he had struck the water.

The curves on page 51 were presented to a class of students in comparative psychology who had heard a discussion of the various methods of learning employed by different species. They were asked to guess which animals were represented by the graphs. Various individuals suggested monkeys, cats, dogs, chickens, pigs and horses.

No one in the class guessed that they were really pictures of a certain learning process in college students!

They show the time required by various students to solve difficult mechanical puzzles, of the kind which, try as they would, they could not "see through." The puzzle required that one separate

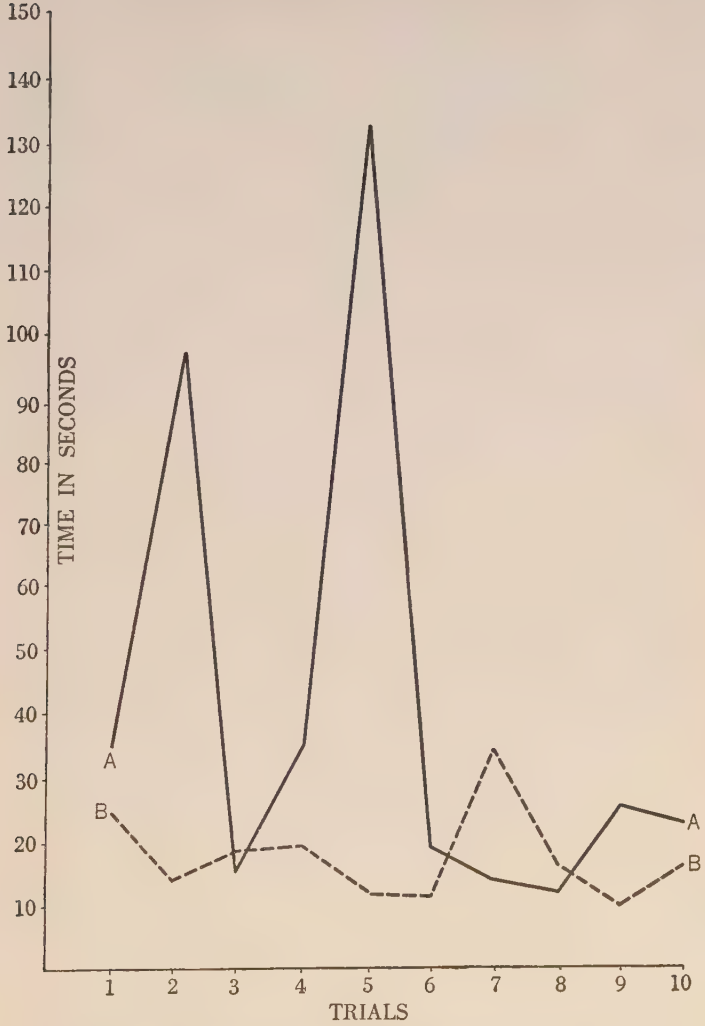

FIG. III.—Time curves for each of two students who learned to solve a mechanical puzzle by the "animal method."

two pieces of metal. In the course of twisting and turning suddenly the two pieces seemed to fall apart. The second trial was often no better than the first, the third little better than either of these, for the student though she had by chance operated the mechanism which solved the puzzle had no idea which of her movements were effective and which were ineffective. She must try again, and only gradually did useless moves drop out. In this case her learning was much like that of the cat's; it did not come mainly through an understanding of the situation but through trial and chance success.

Conclusions reached by the experimental method differ then from those arrived at by the compiling of anecdotes. In the latter case the cat is credited with a method of learning similar to that of man at his best. She is said to solve problems by thinking out their solutions. Experiments demonstrate, however, that the cat is incapable, within the limits of the investigations, of employing this method, but that she uses instead man's second best procedure, hit-or-miss varied struggling, guided by accidental solution.

CHAPTER IV

THE CAT COMPARED WITH OTHER ANIMALS

Cats I loathe, who, sleek and fat,
Shiver at a Norway rat.
Rough and hardy, bold and free,
Be the cat that's made for me,
He whose nervous paw can take
My lady's lapdog by the neck,
With furious hiss attack the hen,
And snatch a chicken from the pen.
—*Dr. Erasmus Darwin* (37).

Believing that the experimental method is superior in accuracy to the method of anecdote, we may ask the comparative psychologist to tell us not only what feats cats can learn and how that acquisition takes place, but also, if he can, how cats compare in ability with other animals. We have seen that human methods of learning frequently, though not always, resemble cat methods of learning. Do chickens and monkeys proceed in similar ways? The dog is commonly described as being more intelligent than the cat. Is this true? How does the cat compare in speed of learning or acuteness with her ancient enemies, the mouse or rat, or with the raccoon, or the horse?

The investigations which make possible a comparison of various species have a more important

function. They attempt once more to demonstrate whether the cat or other animals show evidence of the possession of ideas, of learning by thinking rather than learning by eliminating useless movements. The college professor who has been thrown in the swimming pool will be able to recall his experience, to call up mentally a picture of the pool, perhaps he will hear—again mentally—the sound of the splash, perhaps he will feel, when he is telling the story, his own struggling movements. He will at least be capable of thinking in some fashion or other about the event which is not now present. Does the cat have a similar mental image of the box from which she escaped, of the loop which she pulled, or a similar thought about her experience? When temporarily absent from her nest in the woodshed does she carry about with her a mental image of five grey kittens snuggled together in the straw or seem to hear their faint cries? Does she anticipate her adversary, the neighbour's cat, and, in her absence, see her as large, snarling, striped, with protruding claws, or does she meditate on plans of attack?

We have seen that in learning to solve the problems described in the last chapter, the cat gives no evidence of proceeding by means of thoughts about the situation, ideas, or mental pictures. Several other ingenious experiments have been devised to test whether animals have (or use) memory ideas. Of these, five bearing especially on the problem of

the cat mind will be reported here. Thorndike (52) performed the investigations which we have just described, not only on cats but also on dogs, chickens and monkeys. Another observer (Shepherd) (44) compared the ability of monkeys, dogs, and cats in what he called "Adaptive Intelligence." Hamilton (20) contrasted the reaction to a simple apparatus of a normal man, a defective man, five normal boys, one defective boy, one infant, five monkeys, sixteen dogs, seven cats and one horse! The ability to delay reaction has been studied by a number of investigators, including Hunter (24), Yarborough (67), Walton (56), and Cowan (12), in the case of cats, dogs, raccoons, rats and children. Hobhouse (22) who tested not only his cat, Tim, but a dog, Jack, two elephants (Sally and Lily) and Billy the otter, failed to make accurate time records, and varied his procedure so much from animal to animal that no accurate comparison of species is possible from his experiment.

Thorndike (52) tried three dogs in boxes similar to those which he used with cats. The dogs were very much less vigorous in their struggles than the cats, they gave up sooner, seemed to pay attention to the food rather than to the process of escape. Their bodily structure is, of course, very unlike that of the cats and in this case there was a difference in motive too, for the dogs were not nearly so hungry; all of which makes a comparison of the species very difficult. Thorndike says, however,

that it is his opinion that dogs are "more generally intelligent."

It was apparent that chicks were inferior to both dogs and cats in speed of learning simple performances and in the difficulty of the tasks which they could learn, and on the other hand, that monkeys were decidedly superior to all these animals. The monkeys not only learned to operate more complex mechanisms with greater speed, but employed a superior method of acquisition. After a successful operation of a mechanism they were much more likely, upon being tried again, to perform the correct movement immediately than were the cats. The curves for the cats showed, as we have seen, a process of slow learning by a "gradual elimination of unsuccessful movements, and a gradual reinforcement of the successful ones"; but the monkey curves showed a "process of sudden acquisition by a rapid, often apparently instantaneous abandonment of the unsuccessful movements and a selection of the appropriate one which rivals in suddenness the selection made by human beings in similar performances." (52) One might say the monkeys appeared to understand, to have some idea of the movement they were to make. The monkey seems "even, in his general random play, to go here and there, pick up this, examine the other, etc., more from having the idea strike him than from feeling like doing it. He seems more like a man at the breakfast table than like a man in a fight." (52)

The monkey in these experiments then often shows evidence of the possession of ideas. In an investigation by Shepherd (44) we get a further notion of the kind of feats which monkeys readily perform, and of which cats and dogs, if the experiment is conclusive, are incapable.

A monkey was confined in a cage. A piece of banana hung by a bit of string about twelve inches away from the cage beyond the reach of the animal. Thrust through the banana was a thin piece of wood which could be grasped by the monkey and the food thus brought in. Ten of eleven monkeys confronted by this situation immediately grasped the stick and secured the food. They did not hesitate, they did not first try to reach the food and in "fumbling about" accidentally hit the stick and so grasp it. They merely seized it and used it, possibly somewhat as we would use a spoon on which a piece of food had been placed or the stick which bears the lollipop. The monkeys were all able, furthermore, to secure food by pressing a lever and to pull in a bucket which had been attached to the end of a string.

Three dogs and two cats were tried with a similar stick thrust through a piece of meat. All five failed utterly! The situation was possibly made easier for the cats than for the monkeys, since the stick which was run through the piece of meat instead of hanging outside projected into the cage. All the cats needed to do in order to obtain their food was

to claw in the stick, but they paid no attention to the stick. They scrambled madly and excitedly about the side of the cage. They failed similarly in the lever experiment.

Possibly we may explain the greater ability of the monkeys in these experiments as due to their superior sensory and motor equipment. Monkeys can see much more clearly than can cats and dogs, they depend more on vision; furthermore, they are much more adept in using their paws, which are structurally quite different from those of the former animals. It may be that the monkey merely perceives the conditions more clearly and is also more adequate to deal with them. Or it may be that superior mental endowment enables him to understand the situation, to adapt to it in a way in which the cat does not.

In a third experiment, the intelligence of the cat is again contrasted unfavorably with that of certain other animals, including the monkey. Hamilton (20), whom we mentioned previously as contrasting the reactions of monkeys, cats, dogs, a horse, normal and defective human beings, both adults and children, used an apparatus which consisted of an entrance box with four doors leading to compartments containing food. The animal was placed in the entrance box. On each trial all of the four doors were shut; three were locked; one was shut but unlocked. The animal's problem was to discover the unlocked door, push it open, and thus

have access to food. Efforts to open the locked doors would of course be unsuccessful. The unlocked door was always one of the three which had been locked on the immediately preceding trial; it was never the one which had on the previous trial given entrance to the food.

Success in this experiment might be roughly measured by the number of attempts to open various doors before the correct one was tried. A record of a large number of trials would mean that the animal was repeating efforts to open doors which he had just tried and found locked and was attempting, perhaps more than once, to enter the impossible door. Whereas in a series studied, eight normal human beings averaged 201 trials, a defective man's score was 217, a defective boy took 237, an infant 315, mature monkeys 291, young monkeys 275, mature dogs 313, and older puppies 333; mature cats averaged 352 trials and kittens 387. The feline records were only exceeded by those of very young puppies (377) and by that of the horse, admittedly a very stupid animal, who required 461 trials.

When the frequency of the various methods of reacting to the situation were studied in the different animals, the cats again showed up very poorly. The most adequate method obviously would be that of making no effort to open the impossible door and of trying each of the possible doors but once. The greatest number of the trials of the adult human subjects were of this type. After a few

attempts they "saw through" the situation and reacted in the most economical way possible. This method of responding was not found in the case of the cats, or in fact, of any of the infra-human animals. A second but inferior method would be to try but once each of the four doors, including that one which should have been eliminated because it was open in the immediately preceding trial. This was the method most frequently used by the defective man and by the monkeys and occasionally by the other animals. These individuals apparently did not realize that the unlocked door was never the one which had been open in the preceding trial, but did in some fashion "recognize" the futility of pushing repeatedly at one of the doors when one or more remained untried.

Such errors as repeatedly attempting to open a given door (with or without an effort to open another door intervening), or neglecting persistently one or more of the exits, was found most frequently in the dogs, cats, the infant and the horse. The mature cats made the mistake of trying the same door a number of times (without making any effort to open another door) and the mistake of persistently avoiding one door more often than did the dogs. One cat, for example, after meeting the situation for the ninety-fifth time, tried the doors in this order (when No. 3 was the open door)—No. 2, No. 1, No. 4, No. 2, No. 1, No. 4, No. 2, No. 4, No. 2, No. 1—and finally No. 3, the correct door. The

author suggests that possibly the addition of more animals to his experimental group would efface these differences but adds that "the writer's experience with these two classes of subjects leads him to believe that the average cat is more prone to manifest" this type "of reaction than is the average dog."

Again we find the cat apparently inferior in the experimental situation to the human being, the monkey, and possibly, though not certainly, to the dog. She does not either get the notion of pulling in food with a stick or see through a situation to the extent of recognizing even vaguely the futility of pushing repeatedly at a locked door or of neglecting persistently one particular exit. She is unable, within the limits of the experiment, to demonstrate that she can acquire what we might describe as complex and relatively abstract ideas. Is it probable that she does not possess even simpler ideas, that she has no imagery, no memory of events in the form of ideas or thoughts?

A fourth experiment puts her in a much more favorable light, at the same time that it gives us some information concerning a common activity of the cat, lying in wait for prey.

A cat is observed watching a mouse-hole for perhaps hours at a time. Why does she remain before this apparently uninteresting object neglecting opportunities to be petted, to play with the tassel of the curtain, to sleep in the corner? Does she

recall the mouse which has gone down there or anticipate its return? If there were two mouse holes side by side, would the cat be able to "remember" down which hole her mouse had gone? How long would this interest in one hole continue to the exclusion of interest in the other? Must the cat keep her head and body pointed in the direction of the right hole or may she go away and returning "remember" the place? This ability to permit a pause to ensue between the application of the stimulus and the eliciting of the response has been studied in connection with the learning of a simple performance by two experiments, in one of which (67) it is possible to contrast the cat's capacity with that of the rat, dog, raccoon, and the human child.

Before it was possible to study their capacity for delay, it was necessary to give both animals and children a period of training. An apparatus was provided which looked roughly like the illustration on page 63. The cat was placed in the entrance box and a light was thrown on near the door of one of the three food boxes. The door with the light was unlocked and the cat might obtain food by merely pushing it open. The other two doors which were unlighted were locked tight and any effort to open them would be thwarted. The cat, then, if she would get food quickly, must learn always to go to the box with the light, whether it was the first, second, or third, and thereby to avoid those doors

which were unlighted. The cats were trained also with a buzzer. They learned to go to the door over which a buzzer was ringing and to avoid other

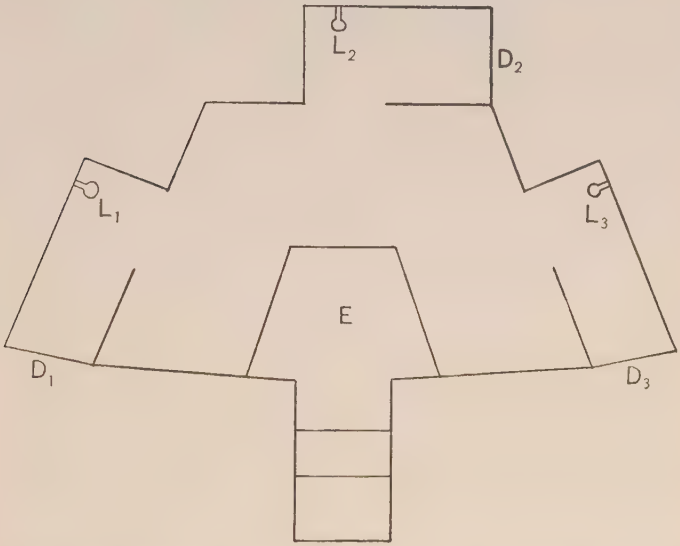

FIG. IV.—Ground plan of apparatus for delayed reaction. (After Washburn.) E is the entrance box; D_1 D_2 D_3 the doors of the three food boxes; L_1 L_2 L_3 the lights near these doors.

doors. In this stage of the experiment, it may be observed, there was no delay, the reaction was immediate.

As might be expected the animals experienced much greater difficulty in learning to respond to the buzzer than they did in learning to respond to the light. The experimenter first records indifference to

the sound. "Bess," he writes, "appears to give no attention to the buzzer" or she "walks about freely without noticing the buzzer." Later on she seemed to be distracted or worried by it. She stopped, turned her head, mewed, as if afraid. "Bess dislikes to go to the sound. She appears shy and afraid of the buzzer. She will venture to the door, stop, and squat, look up at the buzzer and sometimes rise up and 'sniff' at it before going into the box." (67) Later on we find her hesitating and wavering between boxes and finally attending strictly to the sound and reacting in accordance with it. She goes to the proper box from 90 to 100 per cent of the time.

We get the following table of learning times for the cat compared with those for raccoons, rats, dogs, and children in a similar (though not identical) experiment. (24)

Time required for Individual Animals to Learn Response.

Animals.

Raccoons (to light), 120, 340, 540, 825.
Dogs (to light), 560, 650.
Rats (to light), 280, 440, 250, 220, 480, 176, 175, 565, 800, 361.
Cats (to light), 130, 110, 170.
(to sound), 180, 70, 110.

Children.

Six-year-old and eight-year-old (to light), 6.
Two-and-a-half-year-old (to light), 46.

The three cats in this experiment do better than any of the rats, or either of the dogs. These dogs, who appeared to be intelligent members of their species, but whose rate of learning was greater than that of the rats, were reported to be apparently helpless when no aid was given by the experimenters. They sat down and "howled" and behaved as though they were lonesome! The cats' records are almost equal in ability to that of the most rapid of the raccoons, and superior to those of the other three raccoons. In so far as these figures are valuable at all, they demonstrate surprising speed of learning of the cats as contrasted with the other mammals.

The experiment performed on the children differed in certain ways from that on the animals. The former were shown a row of three buttons and told that one of them, if pushed, would make a noise, and that if they pushed the noisy button first they would be given a piece of candy. An electric light was switched on over one of the buttons (the one which would make a noise) but no mention of this was made to the children. After about six trials those of six or eight years perceived the relationship between the light and the noisy button and always pushed the right one. The two-and-a-half-year-old child took forty-six trials before she "understood the situation," but even this was, as might be expected, shorter than the quickest learning time for any of the adult animals.

The problem was then rendered more difficult for both children and animals by the introduction of a delay between the application of the stimulus and the response. Here the situation is made more like that of the cat who watches the hole in which the mouse has disappeared. The light (or the buzzer) instead of being left shining (or ringing) above the proper door was first shut off just before the cat reached the box. When she showed herself undisturbed by this it was eliminated when she was halfway to the box; then the stimulus was stopped as soon as the animal had made her first move; and finally it ceased before the cat was allowed to go towards the food. She was kept from reacting for various lengths of time (from two seconds to six seconds) between the extinguishing of the light (or the cessation of the buzzer) and her release. The problems here might be stated roughly as will she "remember" the proper door, for how long a time will she "remember" it, what does she do in the interval between stimulus and release; in other words, if she does remember how is this brought about?

Here we can compare the longest periods of delay in which successful reactions were frequent in the various animals. Whereas the eight-year-old child was able to delay for a half an hour and even to remember the correct button the next day, the child of two and a half only succeeded in delaying for 50 seconds, failing when she was kept for as long as one

minute. The longest delay for the dogs was five minutes, the raccoons twenty-five seconds, and the rats and cats four seconds. The relatively poor showing of the cats is explained by the experimenter as due to the stopping of the training period too early, before the limit of ability was reached. Voluntary delays of greater duration (one of over a minute) were found when the cat, released by the experimenter, merely sat in the box, resting. With continued training the experimenter states, he is sure that they could delay a much longer period. When only two instead of three boxes were used, they were able to react successfully after intervals of from sixteen to eighteen seconds. If, then, there were two mouse holes side by side it is probable that the cat would "remember" down which hole the mouse had gone much longer than if there were three, but possibly, unless some other clue were present, not longer than twenty seconds. We find the cats and the children making relatively few persistent errors, that is going to the same box twice in the same trial, the rats, raccoons, and dogs making a much greater number.

The question of how the animals "remembered" the proper door is answered to a certain extent by observation of their behaviour during the period of delay. The cats always kept their heads or bodies pointed towards the door where the light had appeared. They merely went to the side to which either head or body was directed. If at the moment

of release, they were not correctly oriented; if they had moved perhaps in the interval; if head or body were pointed toward a box where the light had not been shining—they, nevertheless, "followed their noses" and attempted to open one of the locked doors. In this, their behaviour was like that of the rats and quite similar to the dogs', but very different from the reactions of the children or even the raccoons. The children could remember which door they must open even though they had been distracted by hearing stories, playing about the room, or going out of doors during the interval. The raccoons were capable of correct guesses after they had been frightened so that they raced about the cage. The children, and possibly the raccoons, had some sort of idea or notion of the proper direction which they might recall from time to time. The cats, dogs, and rats apparently were capable of no such "memory idea." They merely followed the impulse to go in the direction in which their bodies were pointed.

A further study of dogs (56), however, showed one at least to be capable of reacting correctly even when the cage in which he was confined was rotated (thus disturbing his position) or even when various distractions such as whistles, the sight of meat, etc., were introduced. This dog behaved in typical canine fashion when he made an error, sneaking back to the experimenter with his tail between his legs and his head down, and though no punishment

of any kind was used, failed to lose his sheepish manner till he had been successful a number of times. When the cage was rotated and a delay required, he often spent his time scratching for fleas or taking little "catnaps." As soon as the box began to swing back into position he was awake and was out of the door before it was half opened, and in spite of naps and flea hunting, more often right than wrong.

Another study (12) along the same line demonstrated that a cat also may remember a direction without maintaining her orientation. This experiment is noteworthy in that the cat was studied in her own home rather than, as is usually the case, in the laboratory. Thus the possible distracting influence of unusual conditions or abnormal environment was eliminated.

Mitzi was a pure-bred yellow Persian female cat six years old who is thus described: "In disposition she was entirely amiable and utterly fearless. She had never met with anything but kindness and never showed a disposition to be anything but obliging." The experimenter says: "She was acquainted with me and very friendly toward me for some time before I began the experiments and during their progress she grew fond of me."

Mitzi sat on her mistress' lap in the living room opposite and equally distant from two doors, both of which led by varying paths to the kitchen. The experimenter appeared in one of these doors

bearing the cat's little tin plate on which lay one piece of kidney. After looking in at the door the experimenter walked to the kitchen and placed plate and kidney under the stove, and then retreated to the porch from whence she could watch, without herself being seen, the cat's movements. If the cat entered the kitchen by the door at which the investigator had appeared, the animal was permitted to eat the meat. If she came through the other door, the experimenter entered quickly, picked up the cat and carried her back to the living room before she got to the meat. Ten tests a day were made for over two months.

Various intervals (from 10 to 30 seconds) were permitted to elapse between the appearance of the experimenter and the release of the cat. She was able to make a satisfactory number of correct responses even with thirty seconds delay (except on one quite understandable occasion when she, like the old-fashioned woman, was so distracted by the presence of a male of her own species in the house that her training failed utterly—she chose the wrong as often as the right and this in spite of the fact that the male was locked ignominiously in the basement). During her undisturbed working periods, however, Mitzi voluntarily lengthened the time of delay by playing with the stop-watch, pencil, or chart, thus bringing the period up to fifty, seventy, or even eighty seconds.

Precautions were taken to insure that she did not

obtain her cue from smell, from some object (as a curtain) set in motion by the experimenter, or from her mistress on whose lap she sat in the first series of tests. The possibility that the mistress gave some cue by a slight movement, was ruled out, by substituting for her as a restraining influence a wire basket which was lowered over the cat and pulled up at the proper moment by a pulley and string which were operated from outside the house. Under these conditions Mitze still chose correctly. Even when the experimenter merely appeared at the door bearing no plate and no kidney, or when an entirely unknown individual was substituted for the investigator, the cat was still able to respond properly. When, however, the experimenter did not appear, but only walked close to the door, in order to discover whether the sound of her footsteps and voice would be sufficient stimulus for the cat, she made a number of incorrect choices and finally "retreated behind an arm-chair in the living room and sulked." She required apparently a visual stimulus.

The most significant feature of the experiment is not perhaps the periods of delay (which do compare quite favorably with those described in the experiment just cited when only two choices were offered) or even the cues used but Mitzi's behaviour during the delay period. She did not maintain a constant orientation, nor invariably proceed in the direction in which head or body was pointed. She often stopped and played, thus turning around per-

haps several times. She did not take a direct path to the door but first walked along a davenport, then jumped down, then chose one door or the other. Sometimes she is described as going to the middle of the room, stopping, looking each way, and then making a correct choice.

Now this behaviour is obviously much more like that of the children and the raccoons described in the previous experiment, than it is like the procedure of the rats or even of the dogs and cats there mentioned. The animal knows where she is going, and knows it in some fashion other than that implied by direct bodily orientation. Perhaps we have here some evidence that cats may anticipate a movement before it is made, that they may have some notion of the direction which they intend taking after an interval, and that this notion may be similar to what we describe as an idea or perhaps an image.

Of course we need many more careful experiments of this character before our conclusions can be anything but speculations. Only one animal was studied here. Such experiments as this last might easily be repeated by other individuals on pet cats. The investigators might discover not only how their particular animals compare in speed of learning and in the possibility of delay with those already tested, but might gather some interesting data regarding the cat's method of acquiring such reactions, and the possibility of her using other clues than bodily position in "remembering." Experi-

ments on pet animals have the disadvantage that they are often not performed with scientific accuracy, the advantage that the animal is tested in a familiar situation. Such a condition as this last would favor the appearance of memory ideas if they exist.

With regard to the comparison of the cat's learning ability with that of other animals, we find these experimenters agreeing with the common-sense notion that the cat is inferior in learning ability to the monkey and superior to the chick and the rat. She appears to be considerably brighter than the horse and possibly, though not certainly, as clever as the raccoon.

One investigator shows her to be decidedly less intelligent than the dog, one finds no reliable difference since both species failed equally at the task which he set them, the fourth reveals the cat to be much superior in speed of learning. We may attribute this variation in opinion to the fact that in each case different animals of possibly different grades of ability were used, and tasks varying in complexity given them. Perhaps there is actually little difference between dog intelligence and cat intelligence, and perhaps those discrepancies which do appear are caused by differences in motor and sensory capacity, or by the fact that whereas the cat habitually attends to the task at hand, the dog usually watches the master. Certainly the experiments give no support to the popular notion that

dogs are universally and surely superior in speed of learning to cats.

Our queries concerning the possession of ideas and images by the cat have resulted in evidence which seems to be on the whole more negative than positive. The method which the cat employs in learning to escape from locked boxes does not imply that she makes any use of memory images or ideas. She fails to acquire such complex and fairly abstract notions as would possibly be essential for solving such problems as that of drawing in a piece of meat on a stick or that of discovering one unlocked door among four. She does not in these experiments perceive the relationship between stick and meat, or learn which one of the four doors will surely be locked, or that persistently neglecting one door or pushing repeatedly at another will be futile. She seems at first sight to be incapable of using any cue other than that of the immediate position of her body, in "remembering" in which direction to go, though a second experiment seems to show her at least in one case capable of some other method of recall. Probably, like most mammals, if she has ideas, thoughts, images, she uses them infrequently. It seems very improbable that she often pictures her absent kittens, her coming battle, or the mouse which has disappeared down the hole. Possibly she merely maintains her position before the hole because of the persisting odor of rodent which lingers about it, or because of slight sounds which she may hear down

the hole. She may have occasional ideas and images of such objects as mice; if she does, the evidence is that they are probably few. To this point we shall return in the concluding chapter.

CHAPTER V

THE CAT'S INSTINCTIVE BEHAVIOUR

There was a wee bit mousikee,
That lived in Gilberaty, O;
It couldna get a bite of cheese,
For cheety—poussie—catty, O.

It said unto the cheesikie:
"Oh, fain wad I be at ye, O,
If it were na for the cruel paws
O' cheety—poussie—catty, O."
—*Old Nursery Rhyme.*

You may force a cat to learn to open a box fastened by an intricate lock, to choose a door where a light has been shown, to wait thirty seconds and still make a correct response. These things the cat may be taught to do. What acts does she perform without training, without learning? Which are instinctive, inherited, born in her?

Much of the cat's behaviour is obviously instinctive. She does not need to learn to breathe, to suck, to swallow, to digest, to sleep, to purr, to mew, to lick herself, to walk, to run, to stretch, to leap, to be sure-footed, to chase small moving objects, to avoid cold, to seek warmth, to mate, to care for her young (keeping them warm, clean, and well fed).

Unlike the dog she directs very little attention to the men around her, unlike the duck she avoids water, unlike the bear she never hibernates, unlike the horse she prefers the dark, unlike the sheep she makes no effort to herd with others of her kind. She (or he) "walks by his wild lone, waving his tail, through the wild woods." She does not need to learn to behave in this fashion. Some of these acts (as sleeping, digesting, breathing, sucking) occur before there has been any opportunity for learning, others (as purring, caring for the young) will appear even in the absence of any such opportunity; and these activities occur universally in all normal cats.

Concerning certain other behaviour, however, authorities are not agreed as to its instinctive character. Are kittens taught, by their mothers perhaps, to catch mice or does there exist within the kitten some mechanism which makes the appearance of the mouse the stimulus for a series of reactions which end in killing and eating? Does the kitten learn mouse-killing, or develop the ability without training? How about homing? Do cats instinctively find their way home when lost, or are the stories of the remarkable ability of the cat to "come back" pure fiction? Is it true that cats when dropped always land on their feet, and if so, how do they manage it? Do cats ever go fishing? How can one reconcile fishing with the cat's well-known distaste for water? Does the weather affect the

cat in any unusual way? Can she ever be used by man as a substitute for the weather bureau?

We shall consider these particular problems here, rather than repeat information concerning the commonly accepted instincts of the cat, not because the former are in any way more important than other instinctive acts (as finding a warm place to sleep, caring for the young), but merely because the questions considered here are less simple of solution, have aroused more controversy and given rise to more experiments. We shall discuss, in order, behaviour in falling, homing, fishing, hunting, and prophesying the weather.

I remember as a child watching a cat leaping playfully from one window ledge to another on the fourth story of a building above a stone pavement. She slipped and fell. I was terrified. A drop of that distance would have killed a man. But the cat jumped right up, seemed a bit disconcerted, and ran away as though frightened. She had landed on her feet!

The cat is able, when she falls, to turn in the air and land squarely on her feet. She has been photographed during the process and investigators have studied not only the mechanics of the reflex, but also the extent of her ability and the sense organs on which it probably depends.

The rotation in the air will occur to one side or the other, depending upon the animal's initial position (18). If she is held with her back down, her

legs inclining to the right, she will turn to that side; if the legs originally point more to the left, the rotation will be in that direction. Motion pictures show that the animal first contracts her fore legs and then turns her fore part around. This makes the hind part turn in the opposite direction but to a less extent. Then she contracts her hind legs, extends the fore legs and gives the hind part a turn. This turns the fore legs a little again in the opposite direction, but again slightly. The cat can turn herself through any angle by continuing contractions of this kind.

Some cats were held by an investigator (32) in a horizontal position with their backs to the floor, then dropped from varying distances on a soft bed of straw. (The bed of straw was provided by a thoughtful experimenter who was not certain of his subjects' prowess.) The cats invariably made the rotation as soon as support was removed. All were able to turn perfectly even when the distance of the fall was only one foot! Some were able to turn in six inches.

Even when unable to see, the cat's reactions were about as perfect and as quick, though their landing on the straw was not so accurate for they were ignorant as to the height of the fall. Even when the organs within the ear (the semi-circular canals) which give both man and animals a perception of the rotation of their bodies, were not functioning, the cats were still capable of turning. Only

when sensations from both eyesight and the sense of equilibrium were cut off were they unable to react. Probably the normal cat depends both on vision and the sense of equilibrium for her cues in performing the falling reflex. It seems also probable that the turning depends on the presence of consciousness and that the unconscious animal does not so react.

Much more complex than the ability to land on one's feet when dropped from a height of a few yards or more is the capacity to "land on one's feet" in the metaphorical sense, to find one's way back when left in a strange place far from home.

It is often said that the cat, though she possesses but a meagre attachment to persons, has a very strong affection for places. Dogs are devoted to individuals whom they follow. The cat tribe possesses lairs to which they return. Giving a cat away is a difficult task. Perhaps your cat is destroying your neighbours' chickens, or perhaps you have grown weary of drowning kittens, and so you give her to your friend who lives a mile away. The next morning, so legend tells us, she will be mewing on your doorstep. Even if you move, taking the cat with you, it may be that she prefers her old home to her new and that she will undertake the difficult journey back, often succeeding in reaching her goal.

A story is told of a cat who returned to her old home 31 miles away the day after she had been

deported. The speed is startling, though of course it is conceivable that the animal, like our present-day "hikers," somehow got a lift. Unfortunately for the story-teller, however, it was discovered some time after the cat's alleged reappearance that the animal seen near the new home was not the former pet at all, but merely another animal of like build and colour!

In his humorous volume *Pussy and Her Language,* Clark (8) tells us of attempting to rid himself of some superfluous kittens by the somewhat cruel expedient of tying a pretty ribbon around each neck and leaving them, in the hope that they might be adopted, some city blocks from home. The mother cat was meanwhile shut in the kitchen. She escaped, our observer does not know how, and somehow found the kittens and brought them back. She succeeded in doing this twice. The *Cat Journal* for April, 1910, mentions an incredible story of a cat who returned after she had been sent by freight, shut in a box, to a place seventy-five miles from home. An old sailor at Pigeon Cove, Massachusetts, is said to have put an unwanted cat in a bag, walked a mile, tied the bag to a large stone with a firm sailor's knot, rowed in a dory some distance from shore and dropped the cat overboard. When he returned home he found the cat purring on his doorstep!

Are all our stories of the remarkable homing powers of cats of this character, or is there a germ of

truth somewhere in the legends? Must we dismiss our favorite tales with the explanation of "coincidence" or "chance occurrence" or even a harsher word, or may we retain some of them as evidence of an ability possessed by cats though relatively unknown to men? If such a power does exist, does it depend on the exercise of such senses as the eye, ear, or nose, or on some other capacity of the animal? Can a cat who has been blindfolded or anæsthetized on the journey out find her way back? Does a cat when first released immediately start for home or must she pause and get her bearings? Over how long a distance is homing probable? These questions experimenters have tried to answer.

Fabre (16), whose description comprises an observation rather than an experiment, recounts quite delightfully the vicissitudes of a family of cats who travelled with him when it became necessary for him to move from Avignon, where he had offended some "old maids" by teaching "whence the lightning comes and the thunder, by what device our thoughts are transmitted across the seas and continents by means of a metal wire; why fire burns and why we breathe; how a seed puts forth shoots and how a flower blossoms." The "shes" and the kittens could be moved easily in a basket, (Fabre does not state how many cats he owned at this period but the reader gets the impression somehow of dozens mewing about him), but the Toms presented more of a problem. One was carried in a

hamper to a friend who lived at the other end of town, but returned very shortly, making his way through a "long labyrinth of crowded streets," and, so the observer believes, crossing the river by swimming. Fabre argues that the cat must have swum across the river rather than have used any of the bridges because his fur was streaming wet. The reader feels inclined to remind the naturalist that swimming a river is not the only way in which a cat can get wet!

On a further move, a cat is reported to have returned a distance of four and a half miles, and again, his belly "covered with red mud proved" that he "overcame his repugnance to water in order to return to his beloved home." This cat was carried in a hamper to the family's new residence, where he was shut up for two weeks in the attic. Released at that time, he immediately made his way back to his former home.

One difficulty with both these stories is that we really do not know that the Toms described were not of a roving disposition. Perhaps they were both in the habit of straying far from home, and therefore the territory which they must traverse in going from a new to an old residence was really familiar ground.

Very interesting indeed was the behaviour of the Tomcat (21) who provided so much amusement for a group of friends one dark summer night on a lake near Madison, Wisconsin. The cat was taken for a

ride in a boat and when some distance from shore became uneasy (much as one's grandmother might do on such an expedition) and anxious to go home. But, unlike grandmother, he did not cling to the centre of the boat but climbed out on one end and stretched his head toward home and mewed continually. The men reacted in characteristic human fashion—by turning the boat slowly round and round to see what the cat would do. But whether "right side, left side, bow or stern, Tom was always on the part of the boat nearest home, and straining as far as he could in that direction. Fully a mile from any shore, how could he tell which shore was which?" He was wrapped in a heavy blanket-shawl, so that he was unable to see, and held either in the experimenter's lap or in the bottom of the boat and the craft then rotated. As soon as he was released he started with no mistake and without the slightest hesitation toward the end of the boat nearest home. Sometimes the boat was turned by a single stroke, sometimes it was rowed slowly round in a circle, it made no difference to Tom. He was as unerring as a compass. The difficulty of this feat can be appreciated by a person who allows himself to be blindfolded in a boat and then tries to guess whether the boat is being turned, rowed in a circle, or in a straight line, or allowed to stand still. The men in this party, encouraged by Tom's success, tried to guess as he had, but their answers were as often wrong as right.

Much more elaborate were the experiments reported in the *Scientific Monthly* by Herrick (21), who attempts in some measure to answer the question of how the cat accomplishes these feats. He describes a female cat, 15 months old, who, because of some differences of opinion with the birds on his lawn he had determined to banish. She had been born and reared on his place and so far as he knew had never left it and "certainly had not shown any roaming tendencies." She was put in a gunny-sack, carried over an "irregular course, mainly by electric car" to the city, 4.6 miles away, where she was given the freedom of two rooms, in one of which the window was lowered a bit at the top. She was fed milk and after an interval seemed to be quite at home. But forty hours after leaving her old home, there she was back again, asking to be let in! In order to make the return journey she must have made her way through city and suburban streets, must have crossed a railroad gully and ascended a series of terraces to a height of 400 feet. Herrick suggests that it would be very difficult to explain her behaviour by ascribing it to movements of the trial and error variety. And such an interpretation does tax the ingenuity of the scientist. We may add, however, that though this attempt succeeded, a subsequent presumed attempt failed—for when the experimenter, wishing to observe the animal's behaviour, gave her another opportunity to escape from her new quarters, she disappeared

and, like the ogre in the fairy tales, was never seen again.

Herrick was moved to experiment on another cat whose owners were willing, because of her predatory habits, to risk her loss. The cat had an additional motive for returning to her home, a litter of kittens which had not yet been weaned. She was placed in a sack and carried by motor-car six times to distances varying from one to three miles, either north, south, east, or west of her home. She was put under a wooden box weighted by stones and released by means of a cord which the experimenter pulled from a green tent 75 to 100 feet away. The purpose of the tent, we assume, was to prevent any distraction which the presence of human observers might afford.

The cat's behaviour on release seemed to be, except when disturbed by inquiring dogs or people, an immediate orientation towards home and a quick start in that direction. She did not pause and sniff in varying directions, nor seem to peer first one way and then another, nor run around in circles seeking the proper direction, nor did she ever backtrack over the course followed by the automobile in coming out, she merely turned in the direction of home and started back. Exactly how long it took her to make the return journey is unknown, since apparently no one was willing to sit up for the cat, and all that could be discovered was that in most cases by the

next morning she was back with her kittens. From a distance of one mile it was observed that she returned in less than eight hours, from a distance of two miles in less than ten, for three miles (this figure was more accurately determined) it took her seventy-eight hours. When she was anæsthetized on the journey out it required eight times as long to make the return trip as it did when she was carried the same distance covered in a bag but without an anæsthetic. Finally her owner (obviously not an experimental psychologist), becoming more and more eager to be rid of her, had her taken to a distance of sixteen and a half miles, whence she never returned.

Experimenters on homing seem to succeed very well in eliminating various possibilities which might be used to explain the home-finding response. They experience much greater difficulty when they seek to make not negative but positive suggestions. They can tell us on what sense organs the cat does not depend but are much more hesitant when they attempt to describe just what clues are used in accomplishing the feat.

The investigator has shown to our satisfaction that the cat's behaviour was independent of vision, hearing, or smell. She was blindfolded, had no clues from hearing, could not have smelled her way back since she did not return over the path taken by the motor-car on the way out. She apparently was

capable of returning over a distance of three miles, and was able to start immediately upon release without pause for orientation.

We are less inclined to accept without reserve a further conclusion based on her behaviour on awakening from the anæsthetic. Herrick asserts that the cat could not have been a nomad. Had she found herself in familiar territory on awakening she would, he believes, have returned home almost as quickly as on former occasions, but instead, it took her almost eight times as long. He assumes that, having lost her orientation, she was forced to wander around until by chance she discovered some well-known place. Here one is inclined to feel that the experimenter places too much emphasis on a single case, and that some other explanations might be possible, such as a lingering effect of the anæsthetic (one perhaps not apparent to the eye of the human observer) or some other accident (as a dog, or an inquisitive little boy, or a nice bowl of milk), or the mere fact that this particular spot was less familiar to the cat than one perhaps a quarter mile away. Perhaps the cat merely lay down and went to sleep, as we are inclined to do on awakening from ether or chloroform.

If, however, we accept the experimenter's conclusions that the cat was homing over unfamiliar territory, we may be inclined also to accept his explanation of her behaviour. Granted that she does not depend on vision, hearing, or smell, or on the mere

recognition of familiar landmarks, we have but one possibility left, that sense which the comparative psychologist often invokes when other explanations fail,—the muscle sense or the kinæsthetic sense. Just as the cat on the boat perceived every movement of the craft and somehow compensated for it, so it may be that this animal maintained a "direction constant with reference to its home region which it retained through the journey out, in spite of all the manifold turnings and twistings to which it was "subjected" (21). You may picture the cat like the compass again, somehow always pointing toward home.

In recounting these tales and experiments, a word of caution is always needed. In a much-quoted paragraph Thorndike says,—"Dogs get lost hundreds of times and no one ever notices it or sends an account of it to a scientific magazine. But let one find his way home from Brooklyn to Yonkers and the fact immediately becomes a circulating anecdote" (52). And so it is with our stories about cats. Some cats apparently are able to return home from distances of about three miles, over territory probably unfamiliar, with no clues from vision or hearing, and over a path different from that taken on the journey out. Are many cats equally anxious or equally proficient? Helen Winslow (64) tells us that her pet cat, "The Pretty Lady," was found very weak and hungry after a five weeks' absence in a field only fifteen minutes walk from her home.

She is described as having no "sense of locality" and as being "wild with delight" upon recognizing her friends. A statistical analysis of the behaviour of fifty pet cats on being removed to new quarters would be of great interest here. The thousands of people who transfer their cats annually from the summer to the winter home should provide us with much valuable data.

Such an inquiry would tell us more surely whether the ability is inherited or whether those cats which display this capacity have learned it. It might inform us further concerning the effectiveness of that old method of keeping the wanderer home, buttering her feet. Perhaps what the butter does is to engage the cat's attention for a time so that she becomes accustomed to her new surroundings. The longer she stays in her new home, obviously, the less probable it will be that she will run away.

So far as I know, this ability has not been tested by authentic experiments with other mammals.

An occasional activity of cats which is interesting to the student of animal behaviour because it is curious rather than typical, acquired and rare rather than instinctive and universal is that of fishing. A writer in the *Natural History Magazine* for March-April, 1926 (19), has summed up for us the instances described by various naturalists of cats who catch fish. Even on Egyptian monuments and tombs, he tells us, are found representations of cats going with

"Do cats ever go fishing? How can one reconcile fishing with the cat's well-known distaste for water?" (See pp. 90-92.)

their masters to fish or retrieving fish from the water. Wild cats occasionally feed on fish. Stories about the house-cat fall in five groups. The cat may be described merely as going with the fisherman, apparently in the hope of sharing the catch, or she may be found all alone by a stream or pond, catching fish by the "scooping-out" process. Occasionally we hear of her going in "all over" to procure the fish, sometimes she brings home her catch, and she is alleged in some stories to train other cats in fishing.

We may quote two of these stories, recognizing, of course, the possible fallacious nature of such evidence:

"I know an instance of a cat bred and reared at a flour mill. It was a universal custom with this pussy to watch by the dam-side, where she might have been seen at any time either in winter or in summer. She used to run along the edge of the water in full tilt after a trout until it stopped; then, seeming to take aim for a few seconds, she would dive down like an arrow from a bow and never failed to land the fish."

"This cat not only fished herself, but taught her children to do so. The way in which she managed this was very amusing, and shows how extremely sagacious feline nature is. When the kittens came of sufficient age she would entice them down some fine sunny day to a part of the stream where the water was very clear and shallow. There the smaller trout-fly and minnows would be gambolling; and, making a spring, pussy would seize one of these and bring it out alive. After letting it jump

around for some little time, to amuse the kittens and attract their undivided attention, she would kill and return it to the stream, jumping after it and playing with it in the water to entice a kitten in. Thus, in the course of time, the kittens could all swim and fish, and rivalled even their mother in quickness and daring."

The first tale is quite explicable as a case of learning by trial and error. Cats who display this ability, according to the author, usually belong to millers. They are accustomed to catch water rats and get into the habit of going into the water to get them. You might picture a cat some day missing the rat at which she was aiming and catching a fish instead. Gradually, perhaps, by such accidents as this, she would build up the habit of fishing. It is said also that one may teach a cat to fish by dropping dead fish in the brook, allowing her to capture these, and thus accustoming her to pursue morsels in the water.

The second story the reader may care to consider in connection with the seventh chapter which is concerned with the early training which kittens may receive, and with our next inquiry. Are kittens taught to catch mice, do they imitate older cats, or is the act instinctive?

There are many stories of cat-mouse enmity and now and then one finds a tale of friendship. The *Literary Digest* (1924) quotes from the *Washington Post* with much zest the story of a cat who, when one of her four kittens died, adopted a mouse in its

stead. The reporter wonders what will happen when the other three kittens open their eyes, and suggests that perhaps the cat is wisely preparing for a future emergency, emulating, we might add, the action of the farmer who fattens a pig and the lady who has a pantry full of preserves.

There are three experimental studies bearing on the ancient problem. A certain divergence of results illustrates the pitfalls into which the student of animal behaviour may readily wander unless he takes many precautions.

Perhaps the best way to discover whether a bit of behaviour is instinctive or learned is to be present the very first time the act is performed and to observe what takes place. So if you wish to discover whether children are instinctively afraid of snakes or whether they learn this fear, you might observe a number of children on the occasion of their first encounter with snakes. You might show some snakes to infants a month old, to children of a year or so, to five-year-olds, etc., and observe what happens. In each case it would be important to know that the child had neither seen a snake before nor heard descriptions nor stories about them, nor derogatory or other comments on snakes.

If you wish to discover just what the instinctive behaviour of a cat is towards a mouse, again you will observe the very first encounter. You need not be concerned, as you are with children, with the possibility that the cat has been told about mice! You

need only be certain that she has never seen one and, perhaps more important, that she has never smelled one.

In 1908 an experimenter (Berry) (3) concluded that cats do not instinctively kill mice, but that they learn, through imitation of their mothers, to do so. His subjects were three Manx kittens, about five months old. The kittens, who had never before seen any mice, were put in a cage on various occasions with various mice. Each one reacted merely by playing with the rodent much as she would with a tennis ball or another kitten. For example:

"Y was in the cage with a gray mouse for 15 minutes. She followed it about striking it gently with her paws. When it ran up the side of the cage she ran up after it and brought it down in her mouth but she did not injure it." The cat's interest was usually only aroused when the mouse began to run. She was likely, however, to grow rougher the longer she played with it, and, if another cat approached to seize the mouse and growl.

We might conclude from such evidence as this that the only instinctive part of the performance was to chase that which runs away, and that there is no instinctive reaction to a mouse as such which involves killing and eating it.

It is to be observed, however, that only three kittens were tested and these only at one age, at five months. It may be that the mouse-killing instinct—if it does exist—appears earlier or later.

Yerkes and Bloomfield (68) tested eight kittens who had been carefully kept in an animal room which was provided with special precautions to make it mouse-proof. These animals were tested at various ages.

They were even tried before their eyes were opened with the odour of mouse. A live mouse was brought near the kittens' noses to see whether they would show special interest in it. But the animals made the same reaction that they did to other unfamiliar odours, as that of weak ammonia, sour yeast, or leather. They merely tried to avoid it. On the twelfth day each of the four kittens was put separately in a cage with a mouse. Again they paid no special attention to it, other than to look at it momentarily when it happened to come near them or touch them.

But when they were about a month old, although three of the kittens still reacted only by following the mouse now and then with their eyes, the fourth kitten seized it in her mouth and growled. The kittens now were tested at intervals of a few days or more. At first they had shown complete lack of interest, now they became more and more attentive to the mouse, they began to play with it, and finally the playing changed to killing! They had had no opportunity for imitation.

One kitten only a month old was put in a cage with a mouse about ten days old whose eyes were not yet open, and the following events occurred:

"The kitten was attracted by the movements of the mouse and touched it with his nose. He then left it. After twelve minutes he happened to be so placed that he could see the mouse as it began to move. For a few seconds he watched as if fascinated by the sight. Then he moved directly and quickly in spite of the shakiness of his legs, to the mouse and seized it in his mouth by the middle of the back, at the same time biting hard, and bending his head to the floor so that one paw could be placed firmly on the body of the mouse. In a few seconds he had bitten it to death. Without pause the process of eating began. It proved a difficult task, notwithstanding the tenderness of the mouse, but after ten minutes of diligent effort and much gagging it was accomplished" (69).

Here, according to the experimenter, you have a kitten only a month old, who had probably never tasted meat, so feeble that it tottered when it walked, seizing a mouse and eating it in just the way that older cats do. He suggests that the situation was made easier for the kitten by the fact that the mouse was suitable in size and strength, so that it was more probable that the instinct would appear than would have been the case had the mouse been agile and tough.

An instance similar to this is reported by another observer (McDougall) (28). He tells the story of a kitten (C) five weeks old who had displayed almost no interest in either young or old white rats who

were put in enclosures with her but who gradually became more excited when a small half-grown wild mouse was put in the tank. "The mouse crouched in a corner and then dashed to the other end, crouched again and again dashed to the other end, repeating this at short intervals, sometimes running close by C. C fixed her gaze on the mouse as it moved, and became gradually more interested, more excited. After some two minutes she prowled after the running mouse at each dash, then began to lash her tail and, as she approached the crouching mouse, growled, then patted the still crouching mouse smartly with her paw. At this the mouse dashed again to the far end. C followed and repeated the tap. This was repeated several times, C showing signs of waxing excitement in the increased energy in her movements. After several such repetitions, C approached the mouse with a savage growl, seized it in her mouth, and in a few seconds the mouse ceased to move and was dead. C crouched, holding the mouse in her jaws, growling savagely. We retired and, returning after five minutes, found that C had completely devoured the mouse."

The next day the kitten became tremendously excited upon smelling a dead mouse. "She growled savagely, she lashed her tail continuously, she struck viciously with her paws at bits of bread lying among the sawdust, she sprang several times in the air with the greatest violence." Two grown

white rats in the cage with her dashed madly about, a small white rat was creeping feebly around—yet the cat ignored these moving objects and concentrated on the dead mouse. When she was left all night in the cage with a large white rat, the two were found in the morning "cuddled together in a blissful rest."

If we contrast the experiments of these last two investigators with that of the first one we see that the opposition in conclusion is due mainly to the difference in the age at which the kittens were tested. The first experimenter observed his kittens only at the age of five months. By this time, presumably, the instinct has waned,—had he tested them before they were three months old he might have obtained a very different result.

Yerkes' conclusions, which are confirmed in general by the results of McDougall's experiments, give us a neat picture of the kitten's instincts. The former finds that the young cat's reaction to mice differs radically from that made to moving lifeless objects and we see from the other experiment that it differs apparently even from the response given to such similar objects as white rats. The instinct commonly appears during the second month, though it may come earlier; it appears suddenly—"in a moment the playful kitten becomes transformed into a beast of prey." The hair bristles, the tail is erected or switched, there occurs hissing, sometimes spitting, growling, unsheathing and sheath-

ing of the claws. Even in the first kill the kitten seizes the mouse by the head, neck, or back, in such a way that it cannot bite.

The instinct is usually first aroused by the movement of the mouse—for the cat seems to possess an impulse to chase any small object that runs away from it. After she has made her first kill the impulse may be aroused by the smell and later on by the appearance of the prey. As cats often bring dead mice to their kittens, probably the young animals become familiar early with this odour.

The other day I watched a six weeks old kitten who, though he had not yet been weaned, had played for days about the house with his mother, with other kittens, with leaves, with bits of string, with the hands and shoes of admiring children. In all his play he never was heard to growl. The mother cat appeared, bringing a dead mouse in her mouth. She accomplished the difficult feat of holding the mouse in her mouth and at the same time calling to the kitten, who after considerable parley came to her. She laid her kill at his feet and retreated a short distance. He sniffed it, then pounced on it, biting it through the part which happened to be uppermost, shook it, threw it in the air, leaped on it again, bit it, all the time uttering the most ludicrous growls. He kept this up for some minutes, then carrying the mouse in his mouth, retired under the house. The observer (on hands and knees) watched him continue his

ferocious behaviour until he seemed to lose track of the mouse's position. Though it lay but a few inches to the side of his nose, and though he seemed to be "hunting" for it, he failed to identify it, and as a passing leaf attracted his attention, left it. Soon the mother came over to where the mouse lay, and with a few strokes of her jaws tore it to pieces and ate it. The incident gives us no clue as to the instinctive character of such behaviour. The kitten, brought up in a stable, had probably been frequently introduced to mice. The only significant part of the act is the appearance of the growl, never previously observed in this animal in spite of his life of almost incessant pursuit of moving objects.

Even on the first encounter with the mouse, the experimenter notes that the kitten may attack it by the neck or back in such a manner that it cannot bite or resist. This method of seizing her prey is almost identical with the cat's manner of picking up and transporting her young kittens. One often wonders how it happens that the cat always lifts her young in the one way that will not injure them. Perhaps we may decide that this is a specific instinctive response. Or we may believe that the cat learns which is the proper handle by trying the tail, perhaps, and meeting with vigorous resistance, and the ears, and again being thwarted, and finally discovering the one method of transportation which the kitten accepts with complacency. Or perhaps

she has learned from carrying mice how to carry kittens, or perhaps the specific method of attacking mice has been transferred to the very different situation of lifting kittens. Some observation of the young cat's first method of handling her litter would be useful here.

Regarding the cat's ability as a weather prophet our data are decidedly inferior; such statements as are presented here are included because of their general interest rather than their scientific validity.

Clark informs us in his amusing way in *Pussy and Her Language* (8) that a cat "is a natural, living, breathing barometer. When a cat washes herself in the ordinary manner, we may be sure of bright, sunshiny weather, but when she licks herself against the grain of her fur or washes herself with her paw over the ear, or sits with her tail to the fire, there will be a storm."

Helen Winslow (64) describes Beauty's prescience thus: "To my grandmother her various attitudes had an undoubted meaning. If on a rainy day Beauty washed her face toward the west, her observant mistress would exclaim: 'See, kitty is washing her face to the west. It will clear!' Or, even when the sky was blue, if Beauty turned eastward for her toilet, the comment would be, "Kitty is washing her face to the east. The storm must be getting "out" (from the sea) and a storm brewing.' And when in the dusk of autumn or winter evening Beauty ran about the room, chasing her tail or

frolicking with her kittens instead of sleeping quietly before the fire as was her wont, my grandmother would look up and say: 'Kitty is wild tonight. The wind will blow hard before morning.' If I sometimes asked her how she knew these things the reply would be, 'My mother told me when I was a little girl.' "

Our two seers do not agree on signs. Neither authority, it is to be noted, has produced any facts to verify his conclusions. Perhaps if we must accept one or the other, we should prefer grandmother's tale for she at least states where she got her information. Could we but substitute the cat for the weather bureau not only would the government be spared considerable expense, but aviators might have an additional reason for taking on their voyages "a small black kitten."

In the *Journal of Comparative Psychology,* Hans von Hentig (55) publishes a description of the reactions of animals (including cats) to such physical changes as earthquakes.

"Dogs and cats," he says, "belong to the class of finest animal seismographs. . . ." Before earthquakes "cats draw back their ears and bristle their fur. Their anxiety is shown by the trembling of their body and the glittering of their eyes. They mew pitifully and behave like raving. Skoupler relates that during the Locus earthquake a cat began so painfully to mew before every shock, that one could hardly bear it."

"Like dogs, cats seek refuge. They press closely to their owners, or even to strangers and forget every former shyness. In one instance it is told that a mother cat carried her young ones with her, as if she were seeking refuge for them too."

Similar disturbances are described in dogs, horses, sheep, goats, birds, fish and insects. According to the author, the earthquake as we experience it is only the conclusion of a series of events; "transformation of energies caused by dislocation of the earth's crust are going on before and after." It is possible that this friction of large earth masses produces electricity. These changes, the author believes, are experienced by animals who behave therefore like delicate seismographs.

The writer does not state how long before an earthquake abnormal behaviour on the part of animals may be observed, nor does he give any indication as to the percent of animals who appear to be disturbed. The inquiry, though subject to all the difficulties which inevitably occur when experimentation is not feasible, provides an interesting field for observation and speculation.

We have reviewed, then, investigations of the cat's ability to turn in the air and land on her feet, to find her way home, to fish, to pursue and kill mice, to prophesy the weather. Of these complex acts only the falling reflex and mouse-killing instinct can be described as certainly instinctive. The cat does not have to learn either to land on her feet nor to

catch and kill mice; most normal cats display this behaviour. Disturbances just before earthquakes would (if genuine) be inherited rather than acquired, since it would be a rare cat who would have more than one experience of an earthquake. Whether homing is an instinct or not is still a question. We have found at least that some cats can find their way home when carried to short distances and that this ability appears to be independent of the senses of vision, hearing, or smell. The fishing observed in a few cats appears to be definitely learned. The cat may learn to catch fish much as she learns to escape from confinement, by trial and accidental success.

CHAPTER VI

THE CAT'S SENSE ORGANS

A little drowsing cat is an image of perfect beatitude. Look at his ears. How big and comical they are. No sound, however faint, escapes them. Look at his eyes. When he opens them wide, how quick and keen their glance. Who is that knocking? Who is that crossing the room?—*Les Chats, Jules Husson Champfleury, translated by Agnes Repplier* (37).

GAUTIER tells a delightful story of "Madame Théophile's" encounter with a green parrot. The cat, after spending some moments in silent contemplation of the bird, decided that what she saw was a green chicken and reasoned further that even if green, the chicken should be good to eat. As she sprang at him, the parrot cried out suddenly, "Have you had your breakfast?" The cat fell back; her thoughts were apparent. "This is not a bird; it speaks; it is a gentleman."

But, the carping critic objects, can the cat distinguish colour? Could she tell a green chicken from a "Rhode Island Red"? Even if we grant that the cat has discovered, as she seems indeed to have done, the distinguishing characteristic of "gentleman," can we admit that she is sensitive to differences of colour as such? Can we be certain, moreover, that she appreciated the humour of the bird's

query? Would the words, "Have you had your breakfast" sound different to the cat from the sentence, "Here comes Johnnie's bulldog?"

Helen Winslow (64) tells us that "Bobinette," a black kitten, who was always kept in ribbons to match his eyes, "knew colour perfectly well. For instance, if we offered him a blue or a red ribbon, he would not be quiet long enough to have it tied on, but show him a yellow one, and he would prance across the room, and not only stand still to have it put on, but purr and evince the greatest pride in it."

A friend of this author's is described as having a cat who is "devoted to blue. When she puts on a particularly pretty blue gown, the cat hastens to get into her lap, put her face down to the material, purr, and manifest the greatest delight; but let the same lady put on a black dress, and the cat will not come near her."

She tells us, furthermore, that her cats were never required to come at the call "Kitty, Kitty," or "Puss, Puss," but that each one of the six answered to his name and "neither would one answer to the name of another, except in occasional instances where jealousy prompts them to do so."

One is inclined to question, in view of the experiments to be reported, whether the first two animals reacted to the yellow or blue colour as such, or in one case, responded to a tone of voice or a gesture of the mistress, and in the other to the texture, the odour, or even the brightness of the garment. One won-

ders, too, whether "jealousy" is the simplest explanation of a cat's answering to a name not her own.

In order to understand adequately the mental make-up of the cat, one must be informed, then, not only concerning her ability to learn, her methods of learning, her capacity as contrasted with that of other species, and her instinctive equipment, but also one must know what sensations and perceptions she is capable of receiving. Does a cat see colours as we do? Can she discriminate sounds? Does my dress look red to the cat as it does to me, is the grass blue, and the curtain green? Are differences between a brown mouse and a white mouse apparent to the cat as differences of colour? Do cats see in the dark? Does a cat perceive the difference between the words "Kitty" and "Pussy," or "Come" and "Do not come," or between the notes of the scale in the same fashion as you and I do? With these questions, we shall be concerned in this chapter.

The problem of the existence of colour-vision in animals has been attacked by a great many investigators, who were interested in discovering whether colours appear to animals as they do to normal men in daylight, or whether animals have vision more like ours in a dim light, perhaps like that of the colour-blind individual to whom red and green (and in some cases blue and yellow) are perceived merely as different shades of gray. To discover whether a man can distinguish between red and green is a rela-

tively simple task; with animals the same problem requires a great deal of time, patience and ingenuity. Many articles have been written and great controversies have been waged over the ability of fish, crabs, bees, or other insects to perceive colour.

If you wished to discover whether a prospective motorman were colour-blind or not, you might proceed in various ways. You might ask him, "Are you colour-blind?" much as you would inquire "Have you ever had appendicitis?" and if he were sufficiently informed concerning methods of studying colour-vision and trustful of your good intentions, his simple "yes" or "no" might be adequate answer. Or you might show him a bit of green paper and ask him to name it, and a bit of red paper and ask him to name that. Both of these methods might lead to errors. Your first inquiry would bring a fallacious answer, were the prospective motorman unable or unwilling to tell the truth. Had the subject never learned the colour names, he would be unable to reply correctly to the second question, even though he had perfect color discrimination. On the other hand, he might say correctly, "This is red" and "This is green," but his answer might be determined, not by a perception of the colour of the paper, but by other factors, possibly even by a chance guess.

A much better method of determining capacity for discriminating colours would be to give your subject a large number of objects, alike in all respects save their colour. You might use a number of bits

of coloured worsted. You show him a piece of red worsted and ask him to pick out all the pieces which are like the sample colour. If he has normal colour-vision, he will choose only the reds, and when you make a similar request with the green, the gray, the blue, or the yellow, he will again choose only those resembling your sample in colour tone. If, however, he is blind to the differences between red and green, he may choose a red to match a green sample, a green to match a red, or a gray to match either of these. He will make errors, too, with yellow and blue (even though he is not blind to the differences between them), his mistakes determined by the fact that many of the blues and yellows in the box are not pure blue or yellow, but blue-green or yellowish-red (orange) or bluish-red (purple), or yellow-green. Not only does he fail to discriminate red and green, he sees them both as if they were shades of gray.

Suppose now you try to make a similar inquiry in the case of your cat. Do red and green look like red and green to her or do they both look like gray? You cannot ask her, "Are you colour-blind?" for she understands neither theories of colour-vision nor human speech; nor, unless you have the simple faith of Professor Grimaldi, can you request her to "Name the colours." Nor will she sort samples of colour for you, a task which a monkey may be induced with some difficulty to perform. She will gladly play with the coloured worsteds, but you will find if you return after an interval that her final disposal of them does

not resemble in the least an orderly arrangement with respect to colour. With the human being we need only suggest the enterprise to have it undertaken. With the cat, to whom we cannot communicate our questions and who would not understand them if we could, we must arrange a situation such that she is forced to demonstrate her ability or her lack of it.

Conditions must be such that it will be to the cat's advantage to discriminate red from green or other colours, and all colours from gray. If she shows ability to distinguish under such circumstances, we may, if all other factors have been carefully controlled, judge that she perceives differences in colour much as we do, if she fails to distinguish and if we are certain that our incentive is adequate, we may judge her to be colour-blind.

The control of other factors is of great importance. Consider the following hypothetical experiment.

Suppose that the cat is confronted with two jelly glasses; one is lined with a piece of red paper, the other with a piece of green. There is food in the one with the red paper, nothing to eat in the one lined with green. If she opens the red jar, her reward will be fish; if she opens the green jar, she will find nothing. Suppose that after your cat is presented with this situation fifty or one hundred times she learns always to go to the red jar and always to neglect the green. May we then assume

that she can distinguish between these two colours, that she perceives the difference between them much as we do? Did "Bobinette" show by "prancing across the room" that he preferred a yellow colour to a blue?

Of course, there are many other possibilities. The cat in the experimental situation may be responding to any one of a dozen things, perhaps merely to the smell of the food, and you might find that if you interchanged your coloured slips she would still go to the right glass. Or it may be that the red glass is always on the right, the green glass always on the left, and that she is reacting therefore to position alone. Or if you alternate, she, too, may be merely alternating her responses. Or there may be differences in the structure of the two glasses, or the texture of the two papers, or their wrinkles and folds, or you yourself may be giving her a clue by a slight movement, as a drawing in of your breath when she is "hot" or "cold." Or finally, it may be that she is responding not to differences in color, as such, but to differences in brightness. Both colors may appear to her much as gray does to us, but one of the two may seem to be brighter than the other.

Two experiments were performed on cats in which efforts were made to control such factors. The earliest investigator (10) used for subjects three dogs, a squirrel, and a kitten. They were allowed to choose between two painted pans. Both were inverted over bits of desirable food. One was painted red, and

this the kitten could remove by inserting her claws under the edge and tipping it over and so obtain the food. The other, which was sometimes a gray pan, sometimes a green pan, sometimes a blue, or orange, or yellow, or violet, was nailed down. All the clawing in the world would not remove it and disclose the food. The experimenter controlled the factor of odour by having food under both of the pans; they both smelled equally of fish or milk; and he repainted the pans so that any possible odour left by the pawing would be covered up. By interchanging the position of the two objects in irregular order, he eliminated direction as a clue. In order to avoid the possibility that the distinction was on the basis of brightness rather than on colour as such, the paints were all matched with the same gray, so that they appeared to the experimenter all to be equal in brightness.

After five or six days, the investigator reports, one kitten learned to claw the pan in such a way that she could obtain food. Another kitten, which failed after several weeks even to learn to open the receptacle, was discarded as a subject. The first kitten learned, furthermore, after another week of training, to discriminate with surprising accuracy the red from the gray. After still more opportunities to learn, she was able to choose red rather than green, blue, yellow, orange, violet, red-orange, or another shade of red, and to do this accurately about sixty-three percent of the time. Often there occurred

several minutes of inspection in which the kitten walked in front of the receptacles before she made an attempt to open them. She gave, he says, "the appearance of actually deliberating," of "making up her mind." He concludes that his kitten shows a surprising ability of color discrimination, a capacity about equal to that of the dogs.

There is one possibility that, in spite of all the precautions, has been overlooked. The colours were, as we have described the experiment, of uniform intensity to the average human eye. But it is now known that colours which appear to be equally bright to the normal eye, are often very different in brightness to the colour-blind eye. Perhaps these colours which were similar in intensity to the experimenter, were really very different to the cat's eye, some of them appearing to be darker than others.

Another experiment tested this possibility (De Voss and Ganson, 14). The procedure was so involved and so time consuming that it required twenty-eight months and one hundred thousand trials to complete the investigation. Three female cats and six males were given each from thirty to one hundred and twenty trials a day. One cat made fifteen thousand discriminations. The animals are reported to have been in excellent health and often picturesquely enough "purred during the experiment."

Food was presented to them in jelly glasses lined with coloured papers. Perhaps a glass lined with yellow and a glass lined with gray would be shown

together. The cat must learn to pull a lever on the yellow glass, which released it in such a manner that she could reach in or tip it over and so get food. The gray glass was locked so that pulling that lever would be unavailing. In the same way other colors were tried in pairs or with grays.

All sorts of precautions were again taken to make certain that the cat's response should depend on colour alone. In order to prevent her choice being influenced by any difference in the appearance of the glasses, the papers were sometimes exchanged so that the glass which had been previously lined with yellow was now lined with gray and vice versa. Perhaps, to the cat, a gray paper smells different from a yellow paper. In order to avoid the possible influence of this factor, behind the gray lining was placed a yellow one (which was, of course, invisible), and behind the yellow, a gray. The two glasses then should smell the same! The amount of food in the glasses was always the same so that this should not in any way determine the choice. The animals were always tested under natural conditions, in day light rather than in artificial light. All differences in form, depth, size, texture, and brightness of the stimulus were eliminated by these and other means. The experimenter even stood in such a position that his reactions could not possibly influence the cat.

Most important of all was the precaution taken to make certain that the colours did not differ in brightness, to the cat's eye. The cat was required

to distinguish yellow (and other colours) not from one gray or a few grays which seemed to be equal in brightness to the human eye, but from a whole series of grays. If the cat is depending on the brightness of the yellow paper for her discrimination, we should expect to find somewhere in the gray series one which is equal in intensity to the yellow to her eyes and which she is therefore incapable of distinguishing from yellow.

Three cats learned to distinguish orange-yellow, yellow, and blue with great success from each one of fifty grays. Surely one might feel that here we have real colour-perception! Some of the grays, however, were more readily distinguished from the yellow than were others. After a long series of experiments, the investigator found some ordinary grayish-white writing paper, very similar in brightness to those gray papers which were so difficult to distinguish from yellow. When this writing paper was used, the cats were utterly confused. They could not distinguish it from yellow. Nor could they distinguish gray cambric from blue paper, or violet, green, yellow, blue, and red from various coloured papers. In these cases, for six hundred trials, there was no increase in the proportion of right choices, and at least two cats failed on each of these discriminations.

Apparently, then, the cat does not perceive colours as we do. You can force her quite readily to react differently to different colours, but the clue on which she depends is not colour at all, but brightness as she

perceives it. The world, we might say, appears to her in grays as it does to the colour-blind person or to a normal person in dim light. Our first experimenter's conclusion that cats show "a surprising ability of colour discrimination" is erroneous.

His conclusion that the cat's ability is similar to that of the dog is quite in accordance with the facts. Though there is fairly satisfactory evidence that fish, frogs, turtles, and birds all possess colour-vision of the human type, the results of a large number of careful experiments suggest colour-blindness in the case of all animals but the monkeys. The cat perceives only shades of gray in the world. So, according to investigators, do dogs, raccoons, mice, rabbits, and bull-calves!

The daylight world is gray to the cat. How do the barn and the fields look at night? We often hear it said that the cat can see in the dark, that she possesses some mysterious sense by which it is possible for her to discriminate objects in the total absence of light. This is, of course, untrue. Cats, like men, cannot see in absolute darkness. But, unlike men, they see very well in a dim light, at twilight, or just before dawn, or in the faint light of the stars on a cloudy night. The pupil of the cat's eye is capable of very great expansion and contraction. Legend tells us that the Chinese tell time by the size of the aperture. The pupil may be widened so greatly that whatever faint light exists is utilized to the best possible advantage. Eyesight

is further supplemented at night by the vibrissae ("whiskers") which enable the animal to feel its way along, by hearing, and by the sense of smell, which, though inferior to that of the dog, is probably acute. If opportunity is given, the cat does most of her hunting at night. Probably the world at night looks much like the world in the daytime (though seen in darker shades), since in neither case does she see reds, greens, blues, and yellows.

Unfortunately, no adequate experiments have been performed on cats to determine the extent of their ability to perceive moving objects, or their capacity to distinguish differences in form. Dogs seem to use vision mainly for detecting movement and are singularly incapable of discriminating between forms. They do not do as well even as the chick in choosing between a striped and plain field. Cats, as we shall show presently, seem to depend more on vision than do dogs. But just how acute is their ability to detect slight movements or to see the difference between a round food box and a square food box, a large dog and one slightly smaller, we do not know.

The cat's hearing is said to be very acute. Can she discriminate fine differences in sound? Does she perceive variations in pitch? If you call to your cat, "Here, kitty, kitty," and at the same time hold out a bowl of milk, she will come running to you. Even if you have no milk and merely stoop down, hold out your hand, and call, she will probably come.

Often a strange cat will run to you in the same way at your command. And your own cat may come to you if you remain standing upright, make no welcoming gesture of any kind, and simply call in your accustomed voice, "Here, kitty, kitty."

Why does the cat come when you speak to ner? Why is it more probable that she will come if you not only call, but beckon, and still more likely if there is added to your vocal and visual invitation the smell of a bowl of milk? Does the cat recognize her name or know what the words, "Come" and "here" mean? or does she merely respond to the general situation of milk, stooping, and calling? If you cat's name is Mary, and you call, "Come, Jane, here Jane," will she refuse to respond? Many persons who do not go as far as the authority on cat speech quoted in the second chapter, in believing that cats possess a definite language, will still claim that their Thomas or Dorothy "understands every word (or practically every word) that is spoken to her."

Two investigators have performed experiments on the discrimination of human speech by cats. Thorndike (52) sat in front of the cage in which one of his cats was placed, clapped his hands and said, "I must feed those cats." After ten seconds he put a piece of fish near the top of the cage. The animal climbed up to get it. After from thirty to sixty trials, the cat arose as soon as the experimenter clapped and announced his intentions and before

he approached with the fish. Another cat was taught to climb up to get fish at the words, "I must feed these cats!" and to make no response to the words, "I will not feed them!" In this case not only were the words not the same, but there was also a difference in emphasis and tone. After sixty trials, the cat learned always to respond to the food signal, but three hundred and eighty experiences were necessary for the animal to learn not to respond to the no-food signal. After eighty days, in which these reactions were not practiced, the cat was tried again. The association between the food signal and climbing up was still perfect. It required fifty trials however, for the animal to learn to make no response to the no-food stimulus.

Before we marvel too much at these animals' understanding, we must relate one more fact about the first cat. She climbed just as readily to the words, "Tomorrow is Tuesday," or "My name is Thorndike," or to the words of a different person who sat in the same chair and called, "I must feed those cats," as she did to the correct signal.

Another investigator (42) tested two ordinary gray house-cats, Mary and her daughter, Pet. The latter was placed in a cage, the investigator sat in front of her. The experimenter called either "Pet" or "No feed." If she called "Pet," she fed the cat; if she called "No feed," she gave her nothing. Pet's ability to discriminate was tested by whether she reared up with her paws on the front of the

cage at the word "Pet," and ignored the words "No feed."

On the third day of experimentation, this animal began to show signs of forming the association and after two hundred and fifty trials (about two weeks of work), had learned to respond perfectly to her name and to inhibit response to the no-food signal, though this second reaction was much more difficult to learn than the first. When other words were substituted for these, when the announcement was made in very loud tones or in low tones, even when another individual made the sounds, the number of correct responses remained about the same.

Mary, who was older and more phlegmatic, learned after twenty-five days to respond to her name, but though she gave evidence of discriminating between the name and "no feed," she was never able to avoid entirely response to this second signal.

The experimenter tells us that the cats took about the same number of trials for learning as did raccoons, four of which were taught in the same way. The investigator is certain that the cats obtained no cue from her, "as we were careful to remain impassive during the trials, and not to give by looks, motions of the hands or body, any clue to the required response, or to allow any perceptible difference of attitude to be exhibited by us when the names Pet and Mary were called and when the other words were articulated."

Later, Pet (43) was trained to discriminate in

similar fashion between two notes sounded on the harmonies or the piano, or between two noises. Pet learned in forty-five trials to respond to the correct note on the harmonica, and to inhibit response to the no-food note. The tones differed by two octaves. After thirty trials, she learned to respond to a difference of one octave on the piano; after forty-nine to discriminate between two octaves. Mary showed some indication of learning to discriminate an interval of one octave, but never entirely inhibited the tendency to respond to the confusion stimulus. Pet learned to distinguish between two noises, one of which was considerably louder than the other, after about forty trials. The experimenter reports that his cats learned more quickly than raccoons, who took from one hundred to one hundred and fifty trials, and were slower than monkeys, who required only thirty or forty trials.

Cats, then, apparently can be taught in about the number of trials mentioned to discriminate between signals given vocally. On what does this discrimination depend? Do they perceive each element separately? Do they depend mainly on tone or on some other factor? We must note two facts here. First, that the cat's discriminative capacity is not very fine; second, that there is one source of error common to all these experiments.

It is not a fine discrimination. The response is to a vague situation. When words were used as stimuli, it was possible to substitute for the original phrase

another vastly different in meaning. If the general form of the remark remained the same (the length of the phrase, the number of the syllables, the emphasis, the tone of voice, perhaps), the cat responded with great readiness. The animal, Thorndike says, "did not have an idea of the sound of I, another of the sound of must, another of the sound of feed" (52); it responded to the phrase as a whole. Only when forced to do so, did it make a distinction between two phrases, and even then the two were probably felt as vague totals. It was always difficult to produce a total inhibition of action at the confusion stimulus.

A possible source of error lies in the fact that the experimenters in both cases remained in the same room with the animals and were visible to them. Even though they attempted, as the second investigator claims, not to give by "looks, motions of the hands or body any cue to the required response," one cannot be at all certain that such a cue was not given unintentionally. A controversy in scientific circles was stirred up some time ago by the performance of a horse who was able apparently not only to communicate his thoughts through an alphabet, expressed by tapping with his hoof, but also to count, to name coins, to detect fine differences of pitch, to tell what day of the week a given date fell on years before, to solve problems mentally in square or cube root! The most astounding thing about his behaviour was that the horse was able to reply cor-

rectly to queries, not only when his master (who might presumably have given him some clue) was present, but also in the master's absence, when strangers were doing the questioning. Sometimes he replied correctly when the problems were not voiced, but only thought. After a long investigation, which typifies most entertainingly the methods of animal psychology, it was discovered that the horse was indeed responding to signals, but that these cues were given not voluntarily by the master, but unconsciously by him and other questioners. The signals were so slight that they could not be detected by the ordinary observer and were only discovered after it was noted that blindfolding the horse disturbed his reactions greatly.

If an animal admittedly as stupid as the horse can be taught to respond to signals so delicate that those who made them were unaware of their existence, it is not unreasonable to suppose that the cat, who is probably a more apt pupil, may learn to make similar responses to signals given with equal lack of intent.

That cats depend more on vision than do dogs has been brought out by the studies of Szymanski (49, 50). Cats and dogs learned to go in a certain direction to find food after they were released from little boxes. After they had formed definite habits of reaction, the box from which they were let loose was rotated so that the relation between the position of the exit and the food was changed. The

problem was now, will the animal still run right or left without regard to the changed situation or will he, after perceiving the difference in the situation, go directly to the place where he was accustomed to find food? If his reaction was of the second type, it may be inferred that he depended more on vision for his cues to action than would be the case did he continue to run in the same direction, without noting the changed conditions. The cats, when they were released, went a few steps, hesitated, moved their heads as though they were trying to orient themselves through vision. As soon as they had located the box, they went straight to the food. Whereas the dogs, on the whole, never hesitated, and required only the same amount of time to reach the food whether the box had been turned but slightly or all the way around, the cats required varying times for their orientation and the length of these periods depended on the angle through which the box had been turned.

The experimenter feels that these differences in procedure are explicable by the differences in the modes of life. Canines (wolves, dogs, jackals, etc.) reach their prey on the run, they must be able to change their direction during the swiftest pursuit in order to follow their booty, which may suddenly disappear entirely in the underbrush, or which may veer around to change the original direction of movement to an opposite one. Cats, on the other hand, lie motionless in their lairs watching for their prey.

They first fix the position of their victims, then rush upon them with lightning-like speed.

Not only do we know that cats in general respond to whole situations rather than to particular elements of the vocal complex; it is also possible that the reactions observed in the experiments were determined as much by vision as by sound. Helen Winslow's six cats probably responded occasionally to each other's name, not through "jealousy," but rather because of incomplete discrimination.

The investigations with the harmonica and the piano make it appear that cats discriminate between tones, between high notes and low notes, much as we do. The probability is, however, that the cats again responded to some signal obtained visually from the experimenter. This possibility was eliminated in an experiment performed by Zeliony (69), who trained a cat to discriminate even when the investigator was in another room.

The cat's food was given to her in a definite place. The investigator provided music with her meals. He sounded a certain note on a pitch pipe for about a minute while she was eating. After he had done this fifteen times, the cat began, as soon as the note was sounded, to run to the place where she was usually fed. This happened even though she was in another room when the whistle was blown. After two months of training, the animal responded invariably to the dinner call, but also reacted just as eagerly to other notes sounded on the same instru-

ment. Then the procedure was varied. When any note but C was played, the experimenter did not feed the cat. She ran into the room expectant. There was nothing to eat. She usually then herself retired to the other room or was carried there by the investigator. Gradually the reactions grew weaker, she came more and more reluctantly, then she ceased to come, then ignored the pipe entirely. Then the tone was sounded which usually accompanied food. The cat appeared immediately.

From such experiments as these, Zeliony feels that he has evidence of a capacity to discriminate between notes a half-tone apart with no possibility of a visual clue. Again we find apparently a very fine distinction of pitch, but here again one factor was not adequately controlled. The notes, though they differed in pitch by only a half-tone, were accompanied by noises and differed, possibly, in intensity. It is quite easy to suppose that it was these noises or a constant difference in intensity (if it occurred), which enabled the cat to discriminate. The possibility that the cat cannot distinguish tones, but depends on other clues, is rendered a probability by the fact that other mammals seem to be tone-deaf. Some birds make very fine pitch discriminations, but rats and dogs, though they have both been proved capable of discriminating noises, are incapable of distinguishing tones.

We find the cat, then, lacking two of the sensory elements which enter so largely into the human

perception of the world. The cat probably sees no colours and distinguishes no pitches. She may be taught to make fine distinctions between hues and between sounds, but these discriminations are based not on a perception of colour or tone differences as such, but on other clues which accompany the stimulus. She lives in a visual world much like ours at twilight, in an auditory world like that of the tone-deaf individual, a colourless and toneless universe.

CHAPTER VII

TRAINING THE CAT

We train the dog to hunt the birds,
  And beat him when he fails;
He works all day and never gets
  A single taste of quails.

The cat is wiser far than he,
  She hunts for birds to eat;
She does not run her legs off, just
  To give some man a treat.

* * * * * *

Man harnesses the lightning, and
  Makes steam perform his will
The horse and dog his bond slaves are,
  The cat eludes him still.
—*Ruth Kimball Gardiner* (62).

Most people do not train their cats. The dog is taught to obey commands, to come when called, to "lie down," to "go home," to stop barking at the milkman or the passing automobile, to refuse food from anyone but his master, to chase the tramp and be friendly to the senator, to "drop it," to play dead dog, to beg, to follow at heel, to waltz, to inhibit jumping up, even, in some cases, to run and get the newspaper or the walking stick.

The cat is taught only to be clean. If a cat as much as learns to beg, she is described by the neigh-

bours as a "trained cat." The *Cat Journal* contains a Medical Department in which the ailments of cats are discussed, but no "Conduct Department" where their manners and morals might be considered. Dogs often become famous because of the tricks which they have been taught to perform. Cats are celebrated because of the length, silkiness, or rich colours of their coats, or the perfection of their features; or, as we have noted, because of the talent of their masters, who describe the animals' natural behaviour with delicacy and charm. It has even been stated that cats as a class are untamable, that their solitary habits and a certain inflexibility which characterizes them makes it impossible for any effective training to be undertaken. The wild members of the cat tribe are tamed best as kittens. They are said to be kept tame only by fear and to perform unwillingly.

But cats can learn. This is evident both from tales of their mental prowess and scientific studies of their abilities. Cats have learned to ring doorbells, pull the cord for the servant, find their way home from great distances, to catch fish. These animals have not been taught to perform tricks. They have learned them without tuition, just as the ordinary cat picks up the trick of coming when you appear with her dinner, of standing at the door and mewing when she wants to go out or to come in, sometimes of scratching the door, of lying down on her back in your path when she desires you to rub

her, of neglecting a scratching sound which comes from your vicinity, of responding to the same noise when the maker is hidden. The average cat-owner does not teach his animal to go to the door when she wishes to be let out. He merely permits her to learn.

Under experimental conditions, cats have been shown to be capable of acquiring even more complex habits. Under the stimulus of reward and punishment they have learned to open boxes fastened in various complex ways, to choose the proper exit even after delay, to respond to certain sounds or lights, and to inhibit response to other very similar ones.

Stables (48) lists the following feats which cats may be taught to do: "to beg like a dog; to embrace you; to pat your nose or your neighbour's nose when told to do so; to down charge; to watch by a mouse's hole [does she need to be taught that?]; to stand in a corner on her hind legs; to move rhythmically to music; to mew when told; to shut her eyes when told; to leap six or eight feet through a loop or over your head; to feign sleep; to feign death; to open or shut a door; to ring the bell; to fish; to swim and retrieve either on the water or on the land." There seems no intrinsic reason why any one with sufficient patience and interest should not teach such tricks to a cat.

Stables taught his cat one spectacular feat, which would fortunately be impossible under modern con-

ditions of hygienic housekeeping. A map of London hung on his wall. If the cat was held up before it she would, on request, place her paw on any one of the principal buildings which he cared to name. The trick astonished his friends, but was quite explicable. He had been in the habit of carrying the cat around and permitting her to catch flies on the wall (!) by placing her paw upon them. The principal buildings on the map of London were marked by black spots, these pussy mistook for flies. You had "merely to hold her in front of the map nearest to the spot which you wished her to touch, elevate your voice when you name the place and the thing was done!"

But suppose you were interested, not in astonishing your friends, but seriously in your cat's education. Suppose that there were certain things that you would like her to learn to do, such as to come at your call, to beg, to fish, and certain others which you wished to train her not to do, such as to sleep on the best chair or chase the robins or the chipmunks or spend hours gazing fascinated at the canary. What methods are most effective? Must one merely arrange conditions so that the cat will, as it were, learn of herself, or can one abridge the learning process, give her an opportunity to imitate another cat, or put her through the performance which your desire her to learn? Consider first teaching her to perform some act which she does not instinctively do, and second, teaching her

to refrain from some behaviour which is native to her.

Will the cat learn more quickly if given an opportunity to imitate? Will seeing another animal doing an act and obtaining a reward make it more probable that a given animal will repeat the performance?

When a child hears his older brother recite a poem and receive the reward of applause and praise from his elders, the younger one usually arises and attempts to "speak a piece," too. The adolescent who infers that knowing the book of etiquette, possessing smooth (or curly) hair, or owning a roadster, has brought his associates popularity, will move heaven and earth to acquire just those things. The older man in a strange hotel may not know the location of the dining-room. Instead of asking, he may watch. Near the dinner hour he will observe a number of people entering a certain door, which had previously been little used. He follows and receives his reward.

These samples of human behaviour are instances of what we might call "inferential or intelligent imitation." The man performs a feat which he has observed to be profitable to his neighbours in the hope of obtaining the same desired effect. He says, as it were, "X did C and the result was A. I shall do C and obtain A too." Do cats learn in this way? If you wished to teach your cat to beg would the best method be to get a trained cat and have her

The spotted cat is using her paw to get the milk which she cannot reach with her mouth. Can the white kitten learn the trick by observing the act and its outcome? (See pp. 132-141.)

perform and be rewarded before your pet? Would it help her any to watch the dog beg, or would a demonstration given for her benefit by the master or his young son be of any aid?

Warren (58) tells a remarkable tale of what he calls "delayed imitation"; in fact, the reader is surprised to discover that the imitation was delayed for about ten years! He describes the behaviour of two brother cats, Tom and Snowball. Tom had learned to take meat from a fork by coming up on the experimenter's lap as he sat in a chair, then going to his shoulder and on his outstretched arm to the meat. Tom remembered this trick over intervals varying from a few months to two years. The other cat, Snowball, was present a great many times while Tom was fed in this way, but, though the experimenter talked to Snowball and coaxed him, he never performed the trick. He had a stunt of his own, pulling the meat from the fork with his paw and thus bringing it to his mouth, and this seemed to content him.

When the cats were ten years old, the experimenter returned after a three years' absence and attempted to get Tom to perform his trick. The cat looked at his old friend, and at the meat, and seemed "puzzled." After considerable coaxing, he seemed to remember it, though not perfectly; he came up "deliberately" and "hesitatingly," not, as he was accustomed to do, "with a rush."

Then came the alleged "delayed imitation." This

behaviour was recorded of Snowball. "Apparently he decided to do what his brother did, for suddenly he came with a scramble to my shoulder and seized the tidbit." And during the rest of the experimenter's stay of two weeks, he always jumped up in just this fashion. "It is certainly very strange," comments the story-teller, "that Snowball should have waited so long before learning his brother's trick, or imitating him, however it may be best expressed, when he had seen it done so many times before. . . . It was not due to any stupidity on his part, I think, for he always seemed as bright, smart and active as his brother; in fact he seemed quicker in some ways." He mentions another brother cat who was present also, but who would not climb at all and so "went without to some extent."

This story may be explained quite readily as a coincidence, for it is, as the writer comments, "certainly very strange that Snowball should have waited so long." Even the reader, who believes that imitation did occur, may qualify his conclusions by noting that we have here only an extraordinary instance reported by the observer as such, not a typical example of the way in which cats learn. It is to be noted that another cat, also present, did not acquire the trick. Fifty percent of the animals tested imitated after ten years. Fifty percent never imitated.

Berry (3), who, as described in the fifth chapter, attempted to prove that catching mice was not in-

stinctive but was learned by imitation, performed some experiments which he felt showed that voluntary imitation of a certain low order exists in cats, and that they, to some extent, imitate human beings. His subjects were three Manx kittens and their mother. He presented his cats with problems which involved various ways of securing meat. The animals might obtain it in one case by jumping from a box to a table, in another by pulling a knot, in still others by turning a button and pulling a loop, by raising a small trap-door, by rolling a ball into a hole, or by fishing the meat out of a bottle. Another situation involved getting down from the top of the cage by means of a board and a jump. All these are examples of tricks which cats can be quite readily taught. Here are some of the examples given of imitation.

Kitten X had learned to open a small trap-door. Kitten Y observed her.

"During the first series of six trials on the last day, Y merely looked on; during the second series, he smelled of the door each time X opened it and during the third series he reached through the door after X had taken out the meat. After X had been taken out of the box upon the conclusion of the third series of trials, Y went to the door and opened it at once. After that he opened the door as fast as I could put in the meat and close it."

A milk bottle was partly filled with cloth and some meat placed on top of the filling. A cat could easily

reach the meat; Y learned in ten minutes to get it out.

Cat Z worked for twenty minutes. Her method was to stick her nose into the bottle and reach for the meat with her paws on the *outside*. Sometimes she tried to get both nose and paw into the bottle at the same time.

X tried for thirty-five, for sixty, for twenty, and for forty minutes at separate trials and was each time unsuccessful. She proceeded by balancing herself with her nose in the bottle and then reaching for the meat simultaneously with both paws. Y was put in with her. "She watched Y very closely as he reached into the bottle and took out the six pieces of meat. After Y was removed X went to the bottle and got the meat in less than two minutes. At first she used her old method but finding that did not work she went at it as Y had done."

In another case the animal (M) refused to turn a button until she had seen another cat (X) do it several times and get meat. After M had turned it once she continued to do so as fast as the experimenter could put in the meat.

These and other cases, the investigator feels, should be described as instances of voluntary imitation, though of a low order. "The cat imitates the act of another with a definite purpose in view." The imitation is of a low order because it does not occur "until the required act had been performed many times by the trained animal."

There are certain objections to ascribing these acts to voluntary, or inferential imitation. The possibility that the acts described here are really accidental successes arrived at after a series of trial and error reactions has not been eliminated. Of one example Berry says merely "her manner seemed to indicate that such was not the case." But we need more evidence than the cat's manner for the exclusion of this possibility. That chance success may have figured is suggested by the fact that occasionally the act that was learned by the imitator was a different one from that performed by the first animal. One cat pulled a loop with her paw, the other with her teeth.

It would be perfectly possible to explain the behaviour of Berry's cats by showing that the opportunity for imitation really functioned by way of attracting the cat's attention to the proper part of the surroundings, to the door, to the loop, to the button, or ball to be touched. The object may be set in motion by the first cat's action. The second cat is then, of course, much more apt to touch it. Or it may merely smell of cat after being pawed about, and again be more likely to stimulate the animal who next meets the situation. Or it may be that kittens tend to follow each other and so that one animal will go in the general direction which another has taken. The second of the three cases which I have quoted may be explained, it seems to me, quite readily as accidental success since even

after seeing Y perform the trick X did not immediately abandon her old method, and the first and third cases as accidental success occurring after the animal's attention had been attracted to the proper part of the environment.

Had Berry's cats had no opportunity to imitate, possibly their learning would have been just as quick. If the experimenter had merely helped the cat, by moving the button so that the animal would more probably claw it or by smearing the loop with catnip so that she would attend to that, success would probably have come even more quickly.

These possibilities are rendered probabilities by the careful work of Thorndike (52) who failed in all the experiments he made to find any instance of genuine intelligent imitation in the cat.

Two cats were put each in a compartment of a box with only a wire screen separating them. One cat had acquired the trick of escaping from her compartment by pulling a string, the other had had no opportunity to learn. The first cat pulled the string, escaped, ate the meat, while the second cat sat watching. After a number of performances of this kind, the second cat was placed in the test compartment and her behaviour observed. This was repeated on a number of occasions with the same cat, and various animals were experimented on in a similar way. In another investigation both cats, the trained and the untrained, were put in the same box. The trained animal pulled the loop, both went

out and were fed. After a number of repetitions of this performance the untrained cat was put in alone and her actions recorded.

In both experiments cats occasionally learned to escape. They did not do so as a result of imitation but in consequence of accidental success following upon a series of almost random reactions. This was evident from their behaviour; a cat who had watched another animal escape by pulling a string was no more likely to attack that string than she was to claw at any other part of the box; she did not pull the string immediately or even at an approximately constant time after being given an opportunity to do so. Often the act which was learned was, as in Berry's investigation, a different one from that performed by the first cat. Had the cat been profiting from the opportunity to imitate, with repeated chances to watch, learning time should decrease. But the more times the imitator saw the act performed the longer it took her to escape, since in these cases her opportunities for learning by trial and error were reduced.

Two cats climbed up eighty times before another cat to get fish. The performance was well within her repertoire; she "wanted," as we say, the fish, yet she never followed the others nor attempted to follow them.

The evidence seems to be, then, that cats do not learn habitually by imitation. Such cases as are reported are probably best explained either as acci-

dental success, as instances of attracting attention to the stimulus and thus facilitating learning, or as extraordinary rather than typical behaviour. In this lack of power to imitate, cats resemble other mammals. No reliable proof of learning by imitation has been reported in mice, rats, dogs, or raccoons and there is much negative evidence. Only in the case of monkeys and apes do we find trustworthy reports of such profiting by the experience of others. Evidently it will not be wise to use imitation as a means of training your cat.

Nor will putting a cat through an act enable her to learn more quickly to perform it. If you wish to teach a cat to go inside a box she will quickly learn to do so if you feed her every time she goes within. If, however, you pick her up and drop her in the box, then feed her, she will not learn to go in herself. Thorndike (52) observed the effect of putting an animal through an act, by placing the cat in a box, leaving her there for a few minutes, and, when she failed to escape, taking her paw and with it pulling down the loop, an act which preceded escape and food. After ten or fifteen such trials the cat was let in alone. No animal which failed to perform such acts in the course of her own activity learned by being put through. In another series of experiments, the observer took the cat's paw and with it pushed against the side of a button which again led to the animal's release from the box and to feeding. Five cats learned to

escape but not by using the paw in this fashion. Three clawed the top of the button, one pushed it around with his nose, another used both methods. The animals learned no more quickly with instruction than without.

Again, these results seem to be substantiated by experiments with other mammals. Dogs fail in similar manner to profit from such teaching and monkeys are likewise unable to learn acts from being put through them. McDougall (28) reports assisting white rats to learn to unlatch boxes. Here the aid was given in the form of directing the rat's activity to the proper locus; pointing his nose towards the latch to be lifted, holding him so that he might most easily claw or poke at the desired point. Hobhouse helped his dog, cat, elephant, and otter in similar fashion.

If, then, giving a cat an opportunity to imitate or putting her through an act are of no avail in teaching her to perform it, how are we going to make her do what we wish? How can we train her?

There are very definite limits to a cat's educability; no one has ever taught a cat to sing a tune, to typewrite, to match colors, to play checkers, or to cook dinner. The act to be performed must be within the cat's repertoire. It must not be one for which she is unfitted by her original nature, by reason of the incapacity of her sense organs or the lack of adjustment of her paws for delicate coördinations, as would be the case were we to choose matching

colours, singing tunes, or typewriting. Nor must the activity be so complex that it is beyond her mental powers, as is obviously true of either checker playing or cooking dinner.

If we choose some act readily performed by the cat's muscles, use a stimulus which the cat can easily perceive and arrange that the performance be, at first at least, a relatively simple one, she will learn with considerable speed. Begging in response to the uplifted hand or to the command is such an act. So are the various methods of escape from boxes, as pulling strings, clawing buttons, licking one's self, described in Chapter III, and the other reactions which we have reported as being taught to cats in the course of experimental investigations.

The cat who is to be taught to beg must first be induced to go through the reaction in response to any stimulus, not necessarily that of the raised hand. You hold a piece of meat above the cat's head. She gets up on her hind legs and reaches for it. This is not quite the reaction that you want. You wish her to sit upon her haunches in the typical begging position. You move the fish around. Perhaps you push her slightly downward, so that she herself naturally continues the movement. As soon as she is actually on her haunches you put the fish in her mouth. Next time you not only provide the fish which you feed as soon as she has assumed the desired attitude, but you say, "Beg, Betty." You continue this training. One day you have no

fish. You merely say "Beg, Betty"; she reacts and you reward her with petting. Or perhaps you merely raise your hand. Both of these stimuli, the "Beg, Betty" and the upraised hand, have occurred every time the cat has sat up and begged. She will respond to them in her accustomed way.

There are three essentials for teaching by this method. You must first of all get the cat to perform the act which you desire to teach her. She will not perform it at your signal "Beg, Betty," but she will respond in this manner to another stimulus, as holding fish above the head. At the same time that you give the natural and effective stimulus (holding up the fish) you provide another stimulus, originally ineffective ("Beg, Betty"), to which you desire her to learn to respond. Because of the way in which cats' (and men's) nervous systems work, it will be possible later to drop out the first natural stimulus, and the second or unnatural one will provoke the response. At first the child's mouth waters when he sees or smells food. Later it responds in the same way to the sight of the dining-room table set with dishes. At first the baby waves its arms and legs only when it actually sees the bottle coming. Later it wriggles ecstatically at the word "bottle," which the nurse has pronounced as she produced it. We soon learn to shiver at the sight of the cold water, to laugh at the mere appearance of the comedian, and to jump at the sight of the firecracker. The ineffective stimulus has become effec-

tive because the two were presented at the same time, and the organism has made a joint response to both.

The ineffective stimulus must not only occur and be (with another effective stimulus) responded to by the desired reaction, but this performance must be repeated a number of times before the act is learned. The cat must escape from the box by clawing the loop not once but many times, before she claws it as soon as she is dropped in. The necessity for repetition is recognized by all animal trainers.

It is not sufficient, however, that the act be repeated. It must also be followed by consequences which we describe as satisfying, or pleasing to the animal. Suppose that you had taught five kittens to run to you when you called them, by feeding them milk when they came, and that you now began treating them differently. When the first kitten came you fed her, when the second kitten came you petted her, the next animal you ignored, the fourth you scolded and on the fifth you threw cold water. Though all five kittens had repeated the same act (running to you at your call) the same number of times they would not now all be equally ready to perform it. The fourth and fifth kittens would probably soon learn to avoid you, while the first and second would still come eagerly. What the third kitten would do is problematical. She would probably soon cease to come unless the habit had been very thoroughly learned.

For training the cat then is needed, first a situation which will produce the desired act in response to two stimuli, one originally effective in producing the response, the other one to which you plan to train the cat to react. The performance must be repeated a number of times. The cat must be rewarded in some effective way for every successful act.

In order to provoke the desired reaction as early as possible in the training you may resort to various devices. If you wish to teach a cat to pull at a loop you may set it in motion or smear it with catnip or fish. Here again, you observe, the cat first responds to the situation catnip plus loop by clawing or biting. Later she makes a very similar response to the loop alone. You turn her so that she faces in the desired direction. If you wish her to employ her fore feet only, you hold her hind feet so that she does not make use of them. If you wish her to jump over your hands, you place a board or cloth in such a way that she cannot walk under them. You do not, however, expect her to imitate another animal nor to acquire a trick from being passively put through it. She will learn only by selecting from her own impulses the one which brings reward.

Suppose now that you wish to teach your cat to inhibit some reaction that is natural to her, to avoid some act. A writer in the *Cat Journal* (January, 1912) describes a most effective method, though one which may be surprising to a cat lover.

Her cat had formed the habit of opening a bandbox in which reposed a large and much cherished plumed hat, and of lying comfortably among the feathers. The hat suffered. The owner discovering the source of the damage devised this plan. She took out the hat, removed the bottom of the hatbox, placed a large bowl of water below it, closed the top of the box and left everything apparently as before. How the cat felt when she leaped, not into soft feathers but into cold water could perhaps only be appreciated by a person who believed he was climbing into bed and instead found himself in the full bathtub. After one trial the cat never returned to the hatbox.

One investigator (17), who reports in detail the number and kinds of birds destroyed by cats, conducted a questionnaire to discover what methods were used to train cats not to catch birds.

He gives the following table showing in each case the number of persons reporting the facts.

Know a cat that will not catch birds	70
Believe cats cannot be taught not to catch birds	305
Believe cats can be taught not to catch birds	62
By whipping	37
By scolding	8
Tying bird to collar or around neck	9
Taking bird away from cat	14
Drenching cat with water	1
Pepper on dead bird	2
Pepper and kerosene on dead bird	1

Does the cat have an instinctive impulse to pursue and capture a mouse? Does she behave in just the same fashion toward a rat, a house mouse, or a wild mouse? Could you train your cat to do this? (See pp. 92-101 and 145-153.)

The replies reflect the widespread opinion as to the difficulty of eliminating any instinctive act. Of those answering the questionnaire, five times as many believed it was impossible to eradicate catching birds as believed it possible. This need not lead us to assume that the training cannot be accomplished, since the untrustworthiness of common opinion is well known. Many people believe that very intelligent children are usually unsocial, under-sized, and below average physically; that monkeys have an "instinct of imitation"; that character may be read by noting the conformation of the head, the texture of the skin, the shape of the features; yet each of these statements is untrue. Perhaps all that the replies to the questionnaire mean is that the task of training cats not to catch birds is somewhat difficult, and therefore infrequently accomplished.

The methods recommended are, in order of frequency, whipping (37), taking bird away from cat (14), tying bird to collar or around neck (9), scolding (8), pepper on dead bird (2), and pepper and kerosene on dead bird (1) and drenching cat with water (1). The author reports that he has had no success with any of these methods, and that he has known all but one (putting pepper and kerosene on the dead bird) to fail. If we examine the possibilities in the light of the principles of animal psychology we shall see where the difficulty lies.

Just as it is necessary when teaching an act to an animal to follow it closely by reward, so when it is desired to eliminate a reaction from an animal's repertoire that act must be connected very closely with discomfort. First of all we must be sure that our punishment is uncomfortable. The author reports that he has known cases where the cats ate the birds which had been treated with red pepper. Obviously, then, the stimulus was not sufficient to produce marked discomfort. The same is true apparently of the method of tying a dead bird around the cat's neck. To a human being such a decoration would be most distasteful, but there is no reason for assuming equal repugnance on the part of the cat. In fact we have every reason to suppose that dead prey is pleasant rather than offensive to cats. A further reason for the lack of success of these and of the other methods employed, is that they do not make the association between the undesired act and the punishment close enough in time. Allowing a cat to sample a dead bird covered with pepper may, if the performance is sufficiently uncomfortable, teach the cat not to eat dead birds; it need, however, have no necessary connection with the acts of stalking and springing. Tying the dead bird around the feline neck, taking the prey away from the cat, may, again, if these punishments are really unpleasant, teach her not to bring the booty into the house or into her master's presence; but they occur so long after the actual killing that the

two are not necessarily associated. The same may be true of whipping, scolding, or drenching with water if these correctives are applied only when the cat is caught with the dripping victim in her mouth.

Another reason for the occasional ineffectiveness of such punishments may be that they are not invariable. Sometimes the cat is caught with the bird in her mouth; then she is punished. She may catch birds away from home, or at night when unobserved and escape punishment altogether. Or her master may be too busy or too sympathetic to apply discomfort on each violation of the law. James says that if a man is trying to form a new habit he must "never suffer an exception to occur until the habit is securely rooted in his life." This applies to cats, too.

Two other methods, one of which is used to train cats not to catch caged birds, and one to train cats not to catch chickens, and an investigation of the most effective strength of punishment, give us some positive suggestions for training. Kittens in bird stores are taught to leave caged birds alone by means of "red-hot knitting needles placed in front of a cage," a cruel but effective method. A kitten may be trained to avoid chickens by "shutting it in a small yard with a spirited hen and her brood. The hen administers the treatment." (17) In both cases as soon as the kitten makes any attempt to approach her prey punishment is applied. When she leaps at

the caged birds she encounters the knitting needles, when she leaps at the chickens she encounters the hen. She never succeeds in any of her attempts; she meets nothing but swift, sharp but brief punishment.

The success of this method of training was demonstrated very clearly by an experiment now famous in the annals of experimental psychology, in which fish were the subjects.

The diet of two perch who had previously been fed on minnows was changed to angleworms. A glass partition was put in the tank where the perch were kept, dividing it into two compartments. On one side the perch swam about, on the other the experimenter placed some minnows. Immediately the perch tried to capture the minnows. They stalked and struck at the little fish, but instead of capturing them, the perch rammed their noses against the glass. Gradually their efforts became less and less violent; finally they ceased to notice the minnows. The glass partition was raised; minnows and perch swam about together. Occasionally the perch would stalk the minnows, but when the larger fish got within a short distance of their prey they turned aside. They had lost their taste for minnows.

The degree of severity of punishment to be meted out to cats is suggested by the following experiment. One experimenter (15) taught eighteen kittens to escape from a box by choosing a light rather than a dark exit. The light exit was a com-

fortable means of escape; the dark one was wired in such a way that the kitten who attempted to go through it would receive an electric shock. The shock was made either weak, medium or strong. The difference between the light and the dark boxes was made either easy to perceive, medium or very difficult.

The experimenter found that when the discrimination was easy to make, the habit was formed more quickly than when the punishment was strong. It required seventy-five trials for the cat to learn the habit with a weak current producing discomfort, only thirty-five when the current was strong. When the discrimination was difficult, however, the medium stimulus was more favourable. The strong current required one hundred and seven trials, the medium only eighty-two. If the task is easy for the kitten, stronger punishment is more effective; if the problem is a difficult one, severe discomfort may only distract her attention from the task in hand. The results of this experiment bear out the common-sense notion that cats are easily frightened and distracted, and that it is wise always to rely on weak incentives rather than strong, if the former can be made effective.

One might suggest, then, that a method of eliminating the preying of cats on birds must provide for punishment which is really unpleasant though not too strong, which shall occur as soon as an effort is made to approach the bird and which shall be

invariable. The experiment with the perch suggests a way. Suppose you put around your cat's neck a collar attached to a long string, the end of which you hold. Before breakfast, when she is hungry, take her out on the front lawn among the robins and permit her to roam freely, to roll in the grass, to chase bits of paper, to lick herself, to sleep on the corner of the porch. As long as she leaves the robins alone she is perfectly comfortable. But as soon as you observe her stalking a bird you gather up the string very cautiously and as she springs you jerk it sharply, not sharply enough to injure her or frighten her too much, but sufficiently to stop the spring and bring what seems to be fear, discomfort, and thwarting, instead of the pleasure of conquest. You do this every time she chases birds, and you never permit her to be outdoors without her string and your guiding hand, until she has shown for sometime a complete disregard for birds, a "distaste" for them. There is no reason why such treatment should not be effective, especially if it is repeated when the impulse shows any signs of reappearing. An additional precaution would be to make certain that the cat is not outdoors when she is too hungry, nor permitted to roam at night when no supervision can be exercised over her movements.

Forbush (17) mentions other methods which have been suggested to prevent the destruction of bird-life by cats. One is killing all guilty cats and thus eventually breeding a race of felines who are not

interested in birds or small game; another almost equally effective is that of confining or tethering the cat in the daytime and keeping it indoors at night. Overfeeding occasionally checks the habit of catching birds, cat guards around birds' nests are often useful; belling the cat sometimes works. One suggestion, that only white cats, whom the birds may see easily, be kept will not save the young birds in the nest or those just learning to fly. These methods are of course not systems of training, but merely ways of preventing damage without educating the cat.

We have found, then, that in teaching a cat to perform an act we must make use of repetition and reward; in training the animal to eliminate a reaction we must apply repetition and punishment. Our main efforts in teaching positive responses are concentrated on insuring that the performance and the signal, which we wish to link together, occur at the same time. We reward the cat in an effective way and make certain that the act is repeated a number of times. The chief causes of difficulty in breaking a habit lie in failure to make the discomfort genuine, invariable, or closely enough associated with the act in time. We make no use of imitation or putting the cat through a performance, since both methods are probably ineffective.

CHAPTER VIII

THE CAT'S EMOTIONS

I observe authors who speak concerning cats with a familiarity and a levity most distasteful.—*Andrew Lang.*

The older authors devote a great deal of space to stories purporting to give evidence of the cat's emotions. If a writer happens to dislike cats, he describes their cruelty, or their treachery; if he likes cats, he tells us of their faithfulness, their compassion for the sick, their conscientiousness.

The Reverend Watson (60), whose book has but one object "which is to show that the inferior animals, or many of them, have a portion of that reason possessed by man," gives this remarkable interpretation of a withdrawal from battle.

"A fine tabby was lurking about a bush in which there was a blackbird's nest containing young ones. The cat was evidently contemplating making a meal of the little birds. The old blackbird, however, suddenly appeared, and with a mother's daring, flew fiercely at the cat. Puss, apparently conscience-stricken, [!!] slunk away, leaving the bird in undisturbed possession of her treasure."

Stables (4) describes another cat with a con-

science. The family kept chickens. Day by day the brood grew less. Cocks, ravens, hawks were suspected, but never the family cat until she began to behave in a curious fashion. "Whenever the subject was brought up, the favourite cat seemed all at once to grow exceedingly uneasy and restless, and finally bolted off through the nearest door." This naturally (?) aroused suspicion and, sure enough, the cat was guilty!

According to the story-tellers, cats are exceedingly adept in detecting criminals, and usually, guided by righteous indignation, take spectacular methods (preferring that of seizing the throat) of accusing those who have murdered their masters. They demonstrate their sympathy by ministering to the sick, assuming the duty of providing meat when it is scarce. One man could not afford meat which he had been ordered to take by the doctor (obviously not a modern practitioner). His "poor, affectionate puss," who had been very "dull and wretched" since her master's illness, brought in a rabbit or a bird every day until he was well. Then sympathy apparently evaporating and native indolence having the upper hand, the offerings ceased (48).

The Reverend Watson's cat induced him to follow her and perform an inquest over her dead kitten. "The yearning mother having thus obtained her object and got her master to enter into her cause and divide her sorrows with her, gradually took comfort" (60).

A cat and a canary had learned to dwell in amity. The bird was accustomed to perch on the cat's back, she being "evidently delighted." When a strange cat entered the room, the friendly cat seized the canary in her mouth and "leaped with it on the bed, her hair bristling, her tail stiffening out, and her eyes twice their natural size." (60) The author says the cat's motive was to save "her friend from the intruder." He did not know that a cat will do this with any object, especially with a mouse, with which it happens to be playing, when another cat appears on the scene. Even Romanes (40) describes the motives of cats in human terms thus—"The feelings that prompt a cat to torture a captured mouse can only, I think, be assigned to the category to which by common consent they are ascribed—delight in torturing for torture's sake." Matthew Arnold says of Atossa,

> Cruel, but composed and bland,
> Dumb, inscrutable and grand,
> So Tiberius might have sat,
> Had Tiberius been a cat.

But we should not even attempt to list the characterizations of the poets.

Do cats experience emotions as men do? Does the cat feel excitement when she sights the mouse, delight when she captures it, disappointment when it escapes? Is she consciously affectionate when she rubs against you or when she licks her kittens? Does she mourn the drowned? Is she frightened

as she scrambles up the tree, outdistancing some dog? Is it rage that two cats experience when they battle at night?

Again, we may review the experimental studies of cats in situations which would produce emotion in man to discover what these animals do under such circumstances, and from what they do we may argue with more or less accuracy to what they feel. The emotional behaviour of cats may be studied by two types of procedure.

The acute observer may note the changes in the animal's appearance and action which occur under different conditions of stimulation. The cat who is being petted, the one who is playing, the one who is chasing a mouse present very different pictures even to the unpracticed observer. One may watch a sudden transformation; long before the master sees the dog, he knows by the changed aspect of his cat that one is approaching. The cat who smells a mouse changes instantly from a contented, purring pussy to a terrible beast of prey.

The second type of observation is made by physiologists who are interested not only in the external appearance of emotion but in the internal changes which may accompany it. By the X-ray, by various delicate tests which determine the amount of activity of different glands or the chemical constitution of the blood, they may discover what occurs in the cat's stomach, intestines, heart, lungs, blood stream when she is, as we say, "excited" or "angry"

or "afraid." Such researches have yielded information of great value in the study of human emotion for in their internal changes at least, men and cats are much alike.

Clark, in his humorous account of *Pussy and Her Language* (8), proceeds by our first method. He describes communication between cats, not only vocal, but also through gestures, which includes the "language of the tail." "When the cat's tail is raised, when she flies it, as it were, as a flagstaff, she is satisfied and proud; when she curls it under her body, this signifies fear; when she twitches it, amusement; when she lashes it from side to side, the meaning is 'extermination'; when she points her tail toward the fire, it is a sign of rain."

Even though we may think the last conclusion unjustified and even though we may be unwilling to admit that the cat experiences "amusement," the interpretation of the raised, or curled, or lashed tail appears to most of us to accord with observation.

With the condition which this author identifies as pride or satisfaction and which Darwin (13) describes as feeling affectionate and caressing her master, goes, according to the latter, not only a stiff and upright tail, but also erect and pointed ears, a closed mouth, and an upright position with a slightly arched back. The cat rubs against her master's legs, or against the door-post, or the chair, or any convenient object. If she is lying on something soft and warm she may push against it

with her fore feet, pressing first one foot and then the other, with her toes spread out and her claws slightly extended. Sometimes she sucks at any substance which she may get in her mouth.

If she is preparing to fight another cat her appearance and behaviour are almost exactly the antithesis of those just described. Her tail is not erect but lashed or curled from side to side; her ears are not pointed but pressed against her head; her mouth is not closed but partly open, showing her teeth; instead of standing upright with arched back she crouches with her body extended and occasionally she lashes out with her fore feet, her claws unsheathed. Even the cat who is, as we say, unconscious, whose cerebral hemispheres have been rendered by operation incapable of functioning will, if vigorously stimulated, draw back her lips, snarl and snap.

If she is frightened (perhaps by a dog) she stands again at full height, arching her back, not slightly this time but to a considerable height. Her hair stands on end; her ears are drawn back; her teeth bared.

The dog's attitude when in good humor or when enraged is almost the opposite of that assumed by the cat. The dog responds to the caress of his master by crouching, or at least sinking down, with his tail lowered; whereas the cat assumes the erect position with raised tail. The dog's bearing when hostile is upright and stiff, his tail is erect, his hair

bristles. The cat when savage assumes a crouching attitude similar to that of the dog when he is greeting a friend.

Various explanations are offered of these expressions, and these interpretations may apply to the behaviour of other animals, including man, as well as to the attitudes of the dog and cat. We may assume that the animal when hostile adopts an attitude preparatory to combat. The dog is stiff, all his muscles tense in readiness for strenuous exertion. The cat, who lies concealed waiting for her victim much more frequently than does the dog, and who uses her fore feet in combat, is better served by a crouching attitude. Her teeth are bared ready for use, her claws unsheathed, her ears pressed close against her head are least likely to be torn in battle. When the situation is the opposite of the one which provokes savage demeanour, when the animal is as we say, "friendly," it assumes, according to Darwin, an attitude the antithesis of that adopted when hostile. The dog who stands erect when ready to fight, crouches when friendly. The cat who sinks down when savage, is upright in good humour. Similarly the expression of the tail, mouth, ears, are altered so that in friendly behaviour they are the opposite of those in unfriendly behaviour.

The impulse to rub against something is explained as originating with the fondling of the young, or the playing together of infant animals. Pushing the fore feet alternately is probably a survival of the

act of pressing against the mammary glands of the mother, which kittens, puppies and other young animals may be observed to do. The appearance of the cat in fright is again a preparation for strenuous activity, for her ears are drawn back and her mouth is open. Here, however, the cat is erect, and most striking of all her hair bristles. She looks like twice as much cat, as she does when calm and purring. Perhaps the function of this posture is to make the animal appear as large and as terrifying as possible. The adversary may be frightened and may withdraw, and the situation thus end without danger of injury.

These explanations may be classed in two types. The animal's emotional expression may be described either as an act useful to it under the circumstances, as the erection of the hair or the baring of the teeth, or as a survival of such an act, as pushing with the fore feet; or, in the second place, the performance may be merely the antithesis of that found in the opposite situation, as with the fawning attitude of the dog, the upright caress of the cat.

Such explanations as these have been used to elucidate, also, the wide-open eyes of astonishment, the curling lips in scorn, the staring eye of fright, and other human emotional expressions.

The internal behaviour of the cat during emotion has been described in a number of careful studies (5). Here the main interest of the experimenter was not in the cat's reactions as such but in the light

which such investigations would throw on human physiological processes.

A young male cat was tied in a holder in order that the movements of his stomach might be observed by means of the X-ray. He was perfectly comfortable, his head was free to move, though his body was somewhat constrained. He became restive and excited and immediately the movements of the stomach (observed through the X-ray) ceased. When he was petted, grew quiet and began to purr, the churning movements of the stomach re-commenced. Elderly female cats who tended to accept the situation of being tied in the holder with calmness showed no stoppage of the normal digestive process. If they became excited, however, the stomach movements ceased. One male cat showed a complete cessation of stomach activity for over an hour, although the only visible sign of excitement was a twitching of the tail, back and forth.

When a barking dog was placed near cats restrained in this manner, some animals again appeared to be quite calm. Others showed the typical arched back and erect hair. A small sample of blood was obtained from the cats, by a simple operation rendered so painless that some of the animals purred when it was going on. Those cats which showed evidence of excitement at the presence of the dog had an excess of a substance called adrenin in the blood, the calm cats had no such excess. When the animal was anæsthetized and the sciatic

nerve was strongly stimulated by an electric current (a procedure which would cause pain were the cat not under the influence of an anæsthetic) there was evidence also of adrenin in the blood.

Confinement in a holder, when accompanied by signs of excitement, caused a similar excess of sugar. Three cats who had accepted with resignation this binding in a holder for periods up to four hours showed no such result. After they had been barked at for a half hour by a little dog, excess sugar appeared.

Muscles which had been fatigued by activity to such an extent that they were no longer capable of normal functioning, returned to their former working level much more quickly than otherwise, when adrenin was present in the blood stream; their strength and endurance was increased by this substance. The blood of cats who were "enraged" (and who were described as snarling, hissing, biting) coagulated much more quickly on exposure to air than did the blood of the same cats before the results of the excitement had time to take effect. The injection of adrenin in the blood produced the same effect as did excitement.

As a result of these experiments on cats and on other animals a whole theory of emotions with important practical bearings has been developed. The strong emotion, as fear or rage, is described as a preparation for strenuous muscular activity, for combat or vigorous escape. A situation provocative

of excitement, a barking dog or constraint for the cat, an insult or a ghost story for the man, arouses a whole series of responses which would facilitate vigorous exertion. As was demonstrated in the experiment we have described, the movements of the stomach cease; adrenin is secreted by the adrenal glands and poured into the blood; there is an increase of sugar in the blood; muscular fatigue is diminished; the coagulation of blood on exposure to air is hastened. The increased secretion of adrenin is responsible for some of these changes; the action of certain nerves produces others. Along with these described effects goes a decrease in gastric secretions, a constriction of the abdominal arteries and a stimulation of the heart and lungs.

These reactions are all useful to the animal who is about to meet an emergency. The side-tracking of the digestive process produced by the cessation of the movements of the stomach, the decrease in the gastric secretion and the constriction of the abdominal arteries, liberates energy which may be utilized in battle. The increased blood supply to the muscles, skin, brain, heart, and lungs, produces more effective circulation through these organs which are active during bodily exertion. The greater strength and endurance of the muscles is obviously useful; the additional amount of sugar in the blood provides more fuel for muscular work; a speedy coagulation aids in preventing hemorrhage from injuries.

These effects, so useful to the cat who is about to engage in battle with another animal, are found in man as well, when he is frightened by a thunderstorm or a graveyard at night, or an earthquake or a good detective story; when he loses his job or his wife, or even his pocketbook; before such an ordeal as making an important public speech or passing an examination; sometimes even when he misses his train or has difficulty in getting a telephone connection or when dinner is late, or when he becomes enthusiastic at a football game. The increased strain on the heart, lungs, arteries, and muscles, the stagnation of digestion and the liberation of blood sugar are obviously wasteful under these circumstances.

The state of the cat when calm and purring (and of the man peacefully at work), is the opposite of that of the animal who is preparing for an emergency, getting ready for strenuous activity. The quiet cat's digestive processes continue efficiently; her pulse, blood-pressure, breathing rate are normal; there is no waste, no excess of blood-sugar or adrenin. Probably an entirely different part of the nervous system is active when the animal is at peace from that section which produces the "emergency reaction." Just as the animal's internal glandular and muscular activities are opposed in the two cases, so, as we have noted before, are the readily observed changes in expressions. The cat's posture in a situation presumably inducing rage is the antithesis of

her posture in a situation presumably inducing affection, her internal reactions in the two cases are similarly opposed.

We have spoken in this chapter of the enraged cat, of the frightened cat, of the calm cat, of the cat in good-humour almost as though we assumed that the animal feels anger, fear, or affection the way that men do. These expressions have been used only for the sake of brevity of report and ease in identifying the situation. In each case we have merely described a condition generally assumed to result from a given situation, and the responses both immediately visible and to be discerned by physiological experiment which any observer may report. We have not answered the question, does the cat feel sympathy, guilt, fear, affection. Does the cat have an experience of rage, similar to the human feeling, which accompanies the bared teeth, the crouch, the growl, the cessation of activity of the stomach, the increase of adrenin?

We have shown in this chapter how she looks, how some of her organs behave in situations similar to those producing emotion in man. We have demonstrated further that this behaviour is very like that displayed by man under similar circumstances. In earlier chapters we showed, however, that in spite of her intelligent appearance and apparently thoughtful behaviour, it was extremely improbable that the cat's conscious states, especially her ideas, were like ours. It will be advisable, in fact, to con-

sider the nature of the cat's mind, or consciousness, most critically. We may then attempt to combine the conclusions of these various chapters and to discover whether the similarity observed in the physiological changes extends still further to the feelings, ideas, thoughts, consciousness of the animal.

CHAPTER IX

THE MIND OF THE CAT

Sphinx of my quiet hearth who deignst to dwell
Friend of my toil, companion of mine ease,
Thine is the lore of Ra and Rameses,
That men forget dost thou remember well,
Beholden still in blinken reveries,
With sombre sea-green gaze inscrutable.
—*Graham R. Tomson* (62).

"Puss" has been portrayed by the story-tellers as a mechanician understand the properties of latches, doors and suction-pumps, as an accurate and punctual nurse, as a sympathetic and forgiving friend, as a miracle-worker capable of projecting her thoughts, as a student of cause and effect, as a member of a secret organization with a language of its own. The historian pictures her as sometimes esteemed as a god, at other times feared as a devil; sometimes worshipped, sometimes persecuted, rarely ignored. The essayists have described her in their own image, as a gentle philosopher, kindly, yet detached from human affairs. Medical men look on her as a useful tool. Bird-lovers think of her as a scourge. In the modern household she is regarded as are some infants, as a combination of ornament and playfellow. What does the scientist think of

the cat? When viewed with a cool and impersonal eye, what is she, as the little boy might ask, really like?

The student of comparative psychology can provide three forms of guidance, certain warnings, observations, and theories.

He suggests that in deciding upon our estimate of the cat we rely only on experiments which have been performed with scientific accuracy, and that in all cases we question both the observations and their interpretations. We should be loath to accept as fact the story of the cat whose kittens had died in an inaccessible place and who, when her mistress observed in her hearing, "I would give ten dollars if those kittens, alive or dead, were out from under the floor," immediately left the room to return with four little corpses—making, however, no subsequent demand for the money. In the same way we are unwilling to accept certain explanations of behaviour. A Manx cat learned not only to open a door, but to make an additional little spring as she went through. That the purpose of this was "to save the tail she never had," the student of comparative psychology, heeding the warning to prefer the simplest explanation, will not believe.

The scientist furthermore has shown us what the cat will do under given conditions, as when she is forced to escape from a box, to "look before she leaps," to find her way home, to listen to the clamour of a little barking dog. The psychologist has guessed

too, about her feelings in these situations. Is he justified in making such assumptions?

One might suggest perhaps that the cat is entirely unconscious, that she resembles sticks and stones, tables and chairs, knives and forks, in having no feelings of any kind. Such a notion is immediately rejected by the average man today. Yet famous philosophers have so argued. Descartes believed that animals were natural machines. He says, "Were there machines exactly resembling in organs and outward form an ape and other irrational animals, we could have no means of knowing that they were in any respect of a different nature from these animals." A pupil of Descartes, Malebranche, says of dogs and cats, that they "eat without pleasure, cry without pain, grow without knowing it, desire nothing, know nothing," and that their appearance of intelligence is due to the fact that "God in making them for self-preservation has constituted their bodies in such a way that they withdraw organically and without knowing it from all that can destroy them and that they seem to fear" (57).

The view current today is that all the higher animals are conscious and that inanimate objects, such as rocks, are unconscious. The difficulty appears when the scientist attempts to draw a line between that which is surely conscious and that which is certainly unconscious. Some theorists have argued that flowers and plants possess feelings resembling, in a rudimentary way, our own. Is a microscopic

animal, as an amœba, capable of experiencing sensations? In what respects are the insect's feelings and sensations similar to, and in what ways different from, our own? Such problems are extremely puzzling.

Washburn (59) has suggested two criteria to use in distinguishing between the conscious and the unconscious. One is speed of learning, the other close structural and functional resemblance to mankind. Stones do not change their behaviour at all as a result of experience nor do any inanimate objects; man acquires new methods of reacting with greater speed than that of any other being; as we go up the scale from the lowest to the highest animals speed of learning continually increases. With this increase in ease of change with experience goes an increased bodily resemblance to man. We know where consciousness surely exists, in man. We know where it probably does not exist, in stones and rocks. Between these two extremes must be a point where consciousness in some form first appears. This point we have never located.

We assume that such animals as cats are conscious, thought experimental evidence of this would be extremely difficult to obtain. Having made this assumption concerning animals so closely allied to man in structure and so relatively swift to learn, we may venture some speculations as to the kind of mental life which they may have. These guesses will be based on the evidence which we have presented

from experiment and also on certain observations of the cat's every-day behaviour.

The experiments which we have cited show certain similarities between the cat's behaviour and man's, and also certain differences. We see her proceeding in "solving a problem," in making an escape from undesired conditions in much the fashion that man acts when he is faced with a situation which he cannot "see through," when he is forced to resort to fumbling about and struggling rather than to thinking and planning, to using his muscles instead of his mind. She can be trained and will learn as man does to eliminate those of her responses which, we assume, are not "satisfying" to her and to repeat those of her reactions which bring her "satisfaction." We find her able to delay her response for half a minute and still to make a correct choice between two objects, and to do this, possibly occasionally as a man would, not by depending on bodily orientation but by some other means. We see that she reacts to situations which we judge should cause emotion in much the fashion that a human being would respond, in both her expressive movements and her internal physiological reactions. She can be taught, though with difficulty, to respond to what seems to us to be slight differences of brightness, and again, with difficulty, to distinguish between various combinations of sound.

In certain respects one may describe her, if one is interested in evaluating her capacities, as superior

to man. A human being is not nearly so efficient in twilight as is the cat, nor as quick, strong, and accurate as she in those activities peculiarly her own, as pouncing on prey or springing. Mortal man possesses (perhaps fortunately) no impulse to leap upon, rend, bite, or "torture" mice, no instinct to lick every warm furry object in sight, nor tendency to chase all small moving objects. That most efficient way of saving one's life, turning in the air and landing on one's feet, is a difficult task for a human being. It is possible, too, that the cat possesses some individual method of becoming oriented to a certain place so that it is easier for her to find her way back than it would be for a man similarily handicapped and forced to return under identical conditions.

Experiments have shown the cat, while possessing all these useful qualities, to be notably below the human level in certain other respects. She is blind to colours and deaf to tones. She shows no evidence of that ability which we describe popularly as "reasoning," she does not suddenly "see through" a situation, she does not learn "by jumps" as man does when he is not only fumbling but thinking. She is apparently unable, for example, to discover that of four doors, three of which are to be unlocked and one locked, the experimenter will never lock the one which has been locked on the previous trial, nor that it is futile to push repeatedly at one door and inefficient to neglect persistently one possibility.

She fails to perceive that the way to obtain meat stuck on the farther end of a stick is to pull the nearer end toward her. She apparently can rarely remember under experimental conditions for more than a minute which of two similar entrances she must approach in order to obtain food. Seeing another cat perform a trick and receive a reward does not lead her to attempt to repeat the act in the hope of a like recompense. Even moving her limbs in the desired direction does not giver her the "idea" of an act. She seems to have few, if any, of those mental elements which we describe as ideas or thoughts.

Observe the cat with her kittens. The story-tellers describe in impassioned fashion anecdotes of maternal love. The cat is said to be one of the most capable, efficient, and affectionate of animal mothers. She is alleged to watch over her children, feed them, bathe them, keep them from harm, educate them in the ways of mouse-hunting and in deportment suitable to the home. Most of all she is said to love her kittens and her affection is described as similar to the solicitude of a human mother for a human child.

The stable cat has five kittens, a gray and white, a brindle, and three jet-black ones. Does she conceive of those kittens as five separate entities as a human mother would? One day when the cat is absent at her dinner, the experimenter removes the gray and white kitten. The cat returns. She lies

on her side and permits the four remaining kittens to suck. She shows not the slightest sign of surprise, of searching for the absent one, of expecting the wanderer to return. She behaves just as she would if all five were present and safe. There is no evidence of her missing the gray and white kitten or of remembering him in any way. Her feeling about her kittens is surely very different from those of the five-year-old child who, on entering the stable, demands, "Where is the other kitty?"

Helen Winslow (64), whom we have quoted before as a great admirer of cats, tells us that the "Pretty Lady," one of six pet cats, produced ninety-three kittens during her lifetime. It was her mistress' habit to drown all but one of the litter as soon as they were born. The cat accepted the situation complacently so long as one was left. If all the kittens were taken away she, of course, showed signs of great distress, caused, one may believe, not by the thwarting of maternal affection, but by the swollen and painful condition of the mammary glands deprived of their usual method of relief. Evidence for this is seen in the fact that even when all the kittens had been destroyed the cat was in the habit of accepting an older kitten of her own "who had not yet outgrown his taste for mother's milk." "Pomp," who was substituted for a newborn infant at one time, is described as almost as big as his mother!

If the kittens are older when they are destroyed,

one may sometimes observe disturbance on the part of the mother, even though one of the litter is left. When the stable cat's kittens were about six weeks old, four of them were taken away, the gray and white one only remaining. After their removal, the cat returned to the empty stall which had been the nursery. She gave that curious call which cats use when they are "talking to" their kittens. Then she waited. She repeated it time after time. She cried. She searched all about through the hay, under boxes, alternately calling and mewing. She came into the kitchen crying. She returned to the barn, called again, waited, and then mewed. When the gray and white kitten came to her she lay down and let him suck. She was restless for over twenty-four hours.

On the desk stood a coloured picture postcard showing a kitten's head. Pressing the card operated a whistle inside, which sounded to human ears just like a kitten crying. When the cat was in the room being petted and content for the moment, the experimenter pushed the whistle. The phantom kitten cried, the cat was all attention. She immediately mewed what seemed to be a response and began hunting. She searched all over the floor, crying each time she heard the mewing sound. Led apparently by the sound, she leaped on the desk and searched through the pigeonholes. She paid no attention, of course, to the paper representation of a cat's head, which was placed directly in her field

of view a number of times, nor to her own image in the mirror. But she hunted, calling.

One might argue, possibly, that the cat had a mental image of the kittens for which she was searching, that she might be able to say, if capable of putting her thoughts into language, "I am looking for four furry objects which scramble about and cry," that she "missed" them, "wondered where they were" and made certain guesses as to their probable location. "Perhaps they are under the hay. If I call I may be able to coax them out." Much more probable is the surmise that the cat experiences a vague restlessness due to two causes, the organic conditions produced by the presence of the surplus milk, and the absence of a number of familiar stimuli. When she comes to the accustomed stall she calls. When there is no response she feels uncomfortable. Whether she has an anticipatory image of a kitten is difficult to say. But there is no reason to suppose that she has a definite idea of the cause of her distress, nor that she can differentiate between the unpleasantness caused by loss of kittens, by hunger, or by a change to a new residence. She doesn't know just what is the matter.

When she is caring for her kittens, a similar lack of ideas resembling human notions is apparent. Does the cat make any effort to see that each kitten obtains its just share of nourishment, or even that it receives any share at all? The cat takes no part in the proceedings at supper other than to lie down

and permit the kittens to struggle for food. If one is too weak, or too sick, or too indolent to search for the teat or to suck, it goes without. If one does not scramble out of its mother's way when she lies down that kitten is in great danger of being rolled upon and crushed. The licking reaction is performed with a similar nonchalance and disregard of its function. The mother is licking her forepaws; a kitten staggering around, pushes between them; the mother's tongue encounters him and he is washed as vigorously as her fore paw was a moment ago. If the kittens are lying in a line sucking, that one who is closest to the "old cat's" mouth is bathed, the others are untouched. Only by himself getting near to his mother's tongue does a kitten receive his washing. In the course of the day possibly all the kittens are licked. But it well may be that gray and white is washed ten times to the brindle's once.

In the so-called education of her litter, the old cat typifies very well that modern way of rearing the young, the project method. The kittens initiate all activities, the cat merely submits. She permits her ears to be chewed, her back to be clawed, her tail to be pursued. As soon as the kittens are old enough to spring she is continually being stalked by one of the five. They are always hiding under shelving ledges and jumping out at her. She seems merely to neglect the constantly recurring stimuli. Occasionally, like a good disciple of the project method, she brings home raw material, raw unfortunately in

both senses of the word, but the kittens for a number of weeks at least are not especially interested in the dying mouse. It is the cat who sniffs it and plays with it. It is very difficult to believe that any idea, however vague, of teaching the kittens is involved in bringing in the prey. In hours of watching in the old horse-barn I have never seen any acts which suggested definite effort at teaching nor any behaviour which could be attributed to maternal solicitude, which gave evidence of anything resembling, even vaguely, ideas of feeding, caring for, or educating the young. Such observations are, of course, of little value, except in so far as they serve to confirm the data of experiments.

We may summarize by contrasting the human consciousness with the cat consciousness. I sit watching the cat; the cat is eyeing me. How do our thoughts differ? In my mind, there is, first of all, a general background of feeling, in this case one of general bodily well-being, of relaxation, and pleasantness. I am conscious of various sensations; I see the cat's general outlines, gray fur, her yellow eyes clearly; each detail of her appearance I am able to observe minutely. I could tell you how far she sprang from the rug to the chair, whether she put her right forepaw or her left forepaw first in my lap; if I cared to expend the necessary time and energy I could count the hairs on her head. I am able to note the exact character of her mewing, and may describe it as loud or soft, as an especially high or an espe-

cially low cry, as plaintive, or urgent, or merely conversational. I become, from time to time, conscious of various sensations of touch obtained from stroking her, but not, unless I pay particular attention to it, of any characteristic odour.

In addition to this vague awareness of the state of my own organism, and to the perceptions of the cat's appearance or behaviour which I may attend to from time to time, there are in my mind certain ideas, memories, thoughts associated with the cat. I may remember her name "Snooky" and decide that it is particularly infelicitous. I may recall certain stories about cats' behaviour. I may try to contrive some new investigations of feline nature. I may have a very clear mental image of her kittens, and may pass from a thought about the kittens, to a memory of the barn in which the kittens dwell, to a picture of the garage next door, the car in the garage, a motor trip, and finally to regions and ideas connected only remotely with the present cat.

Furthermore, there is in consciousness some awareness, however dim, of a purpose, of what I intend doing next. I know that it is time to get up, pick up the animal, and carry her down to her rightful quarters. My intention to do this exists in my mind as a vague feeling in the muscles concerned in arising and as a slight movement of the hand which I shall use in stroking her, and also as a thought about the last time I carried her downstairs.

Are thoughts comparable to these present in the

cat's consciousness? Does she have something corresponding to our own feelings of general pleasantness and unpleasantness, calmness or relief, anger or joy; does she have sensations like ours, memories like ours, and similar conscious tendencies?

From the experimental data which we have cited it seems extremely probable that the cat does experience the general bodily states of pleasure and pain, and those major emotions of fear, anger, general excitement, in a manner comparable though not identical with ours. The cat's heart beats fast during excitement, her adrenal glands are active, her digestion is retarded or stopped, her muscles, lungs, liver, arteries, blood, display characteristic changes just as do ours. Sensations resulting from such changes make up a general conscious state which we identify as excitement, or, when the bodily functions are active in a normal efficient manner, as calm well-being.

There must be minor differences between our feelings and the cat's due to the sensations arising from the erection of the tail, the drawing back of the ears, the hissing which occurs in cats but not in man, and from the smile, the tears, the gestures with the hands, and movements of the smaller muscles of the face which man employs but cats do not. There are more important differences too, which we shall soon describe.

The cat's visual, olfactory, auditory, and other perceptions are probably not nearly so clear, so ac-

curate, nor so detailed as those of the human observer. My cat, as we have shown, does not see colours nor hear tones. Nor does she probably see any object as clearly as I do. Her eye has no fovea, her sense organs of vision are not so highly developed. She probably sees me as a vague form. Just as she does not disinguish the colour of my dress, so it is improbable that she perceives slight variations in facial expressions or that she notes changes in costume. She probably feels me in gross, as a large total thing, the parts of which are but vaguely apprehended.

With sense organs not as fully developed as ours, and with the possibility of movement very much less great, it is improbable that the cat separates from the general background many objects. Her perceptions differ from ours and, therefore, her mental world is different from ours, not only because the former are vaguer and less well-defined, but because she attends to different elements. You may make a long laudatory speech to your cat, but she heeds you not at all. Make a slight scratching sound like a mouse and she is alert and ready for action. Show the cat her picture, a check for ten thousand dollars, the Crown jewels, and she merely settles down to sleep. Bring forth a bowl of milk and she will be under your feet wherever you go. She attends to odours more than men do, to kittens in preference to human babies, to mice and birds rather than dollars and cents, to kidney rather than candy, to dogs

rather than to controversial articles, above all to any dangling or moving objects. She is indifferent to most of the common furniture of man's existence, to books, tennis racquets, sewing machines, dresses and hats, except in so far as these objects serve her as beds, covering, or toys.

Our experimental evidence seems to show, as we have suggested, a lack, or in any case a great dearth, of ideas or thoughts in the cat's mind. The gradual character of learning; the lack of ability to imitate, to get the idea of a movement by being put through it, or to postpone reacting for any length of time; the every-day behaviour of a cat towards her kittens; all these facts may be cited to disprove the existence of conscious memory. As positive evidence we have only one experiment, the delayed reaction investigation, in which a cat (but only one cat) was observed to be able to make a correct reaction after an interval, even though she had not maintained her orientation during the pause and had nothing on which to depend, except perhaps some conscious idea or memory. The cat receives sensory impressions from her own body and from the external world, but probably she only feels these impressions, she does not think about them. She cannot recall how I looked yesterday, nor remember what we did before dinner, nor recall any person, animal, or fact in its absence, nor have any notion, thought, or idea associated with the present object.

For this reason her experience of the general con-

ditions of her organism or even of the sensations she receives must be, again, different from ours. When we feel anger, we experience wrath toward a given individual for a definite reason, "when in the presence of ten jumping tigers we not only feel like running, but also feel the number of tigers, their colour, their size, etc." (52), when we are comfortable and happy, we are prone to think about the condition, to consider the reasons for its existence and methods of prolonging it. The cat cannot think about her well-being or her rage, nor consider, weigh, or compare her impressions.

She probably experiences tendencies to make reactions. She feels like getting up and she does so. But the tendency does not exist in the form of a conscious thought about walking. She does not decide between two alternates, weighing the possibilities, or mentally review the process of walking. From seeing some one else walk across the room, she does not "get the idea." She merely feels like getting up and so reacts. Again the absence of ideas and the general vagueness of her perceptions make her tendencies to reaction of a very different quality from ours.

Picture her, then, living in a colourless, toneless world, a vague world where objects are ill defined and are conceived not in detail but frequently as formless totals. Imagine a mental world devoid of all these facts which we call memories, or ideas or

thoughts about objects, or a universe with such ideas, and then only of the simplest kind, occurring infrequently. In this environment kittens are for a time the main objects of attention, yet they are so vaguely apprehended that four out of five may occasionally be removed without visible disturbance, or a six-months-old kitten may be received as would a new-born infant.

As the cat sits watching me, I cannot believe with the essayists that she is contemplating her last meal, her coming fight, or even that she is engaged in appraising her surroundings. The cat remembers no past and anticipates no distant future. She is either half dozing or else absorbed in reacting to those things present to sense. She is feeling, perhaps dimly, sounds, sights, impulses, her own bodily condition. She is no philosopher, no mechanician, no student or critic of human affairs, merely a distant relative, poverty-stricken with respect to the most valuable of all possessions, but cherished for her air of aloofness and that aura of mystery which surrounds her.

This, at least, is the view of the cat's mind that many students of comparative psychology hold today. Other investigations may be made tomorrow which shall overthrow these theories. A writer in *Harper's* (36) says—

"From science and by reason we as yet know neither whence the universe came nor whence it is

going; what I am that read this, nor what it is that I read, nor whether there is an I, nor what is energy or space or matter; nor the explanation of any force or thing, whether heat or light or electricity, or thought or imagination or love."

We know even less about cats.

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